Evaluation of Pennsylvania's Motorcycle Safety Program

Final Report

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PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

Safety Administration
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Glossary

AAA	American Automobile Association
AMA	American Motorcyclist Association
ABATE	American Bikers Aimed Towards Education
BDL	Bureau of Driver Licensing
BHSTE	Bureau of Highway Safety and Traffic Engineering
BRC	Basic Rider Course
CSM	Covariance structure modeling
DUI	Driving Under the Influence (of alcohol and/or illegal substances)
ERC	Experienced Rider Course
LISREL/PRELIS	Statistical software package for covariance structure modeling
MBAC	Motorcycle-related Business Action Code, typically granting or renewing a Class M license or permit
MSF	Motorcycle Safety Foundation
PAMSP	Pennsylvania Motorcycle Safety Program
NHTSA	National Highway Traffic Safety Administration
NS	indicates a non-significant statistical finding
PennDOT	Pennsylvania Department of Transportation
SPSS	Statistical Package for the Social Sciences
TRB	Transportation Research Board

Executive Summary

Consistent with national trends, from 2000 to 2007 Pennsylvania's motorcycle crashes increased by 44.6% (PA Legislative Budget and Finance Committee Report, June 2008). One important route to increase motorcycle safety begins with an examination of the effectiveness of the Pennsylvania Motorcycle Safety Program (PAMSP). The PAMSP, in operation since 1985, is intended to help improve driving habits among motorcyclists by teaching drivers of all experience levels the fundamental knowledge and skills needed to reduce risk and to operate safely. Two courses are offered, a Basic Rider Course (BRC) geared toward beginning motorcycle drivers and an Experienced Rider Course (ERC) that emphasizes advanced skills. This report describes an evidence-based evaluation that integrates quantitative and qualitative information with a goal of formulating practical strategies and techniques to improve the PAMSP, motorcycle driver education, and other practices related to motorcycle safety.

Although helmet use (i.e., wearing a helmet) is an important motorcycle safety factor of enduring national concern, helmet use was not a primary focus of this study. Instead, helmet use as a factor in motorcycle crash outcomes was studied along with other factors such as driver demographics (e.g., age, gender), driving records (i.e., previous driving violations and sanctions), driver choices (e.g., having a proper license, whether to drink and ride), and driver actions (e.g., speeding, over- or under-compensation at curve, other improper driving).

Literature Review

A literature search on the effects of skill and safety training on subsequent driver behavior was conducted. The literature search addressed such topics as factors implicated in motorcycle crashes, effectiveness of safety training courses, and driver characteristics associated with propensity to engage in unsafe driving behavior. The literature search yielded 350 studies, reports, and citations that were summarized in the *Task 1: Literature Review* report.

Survey of Other State Motorcycle Safety Programs

A survey to collect information from other state motorcycle safety programs was conducted. This survey, completed by 25 states, gathered information about their motorcycle safety training programs and licensing practices, and evidence available regarding the effectiveness of these programs and practices. Appendix A includes the survey and a summary of responses.

Observations of Basic and Experienced Rider Courses

Researchers attended the BRC and ERC at five locations across Pennsylvania as observers. These observations provided us with first-hand experience of instructional methods, course content, and student reactions to these courses, as well as variability in training practices across locations. Both the BRC and ERC curricula accommodate three basic learning styles: visual, auditory, and kinesthetic. The courses and instructors accomplished this through the use of videos and demonstrations (visual); lecture, group discussion, stories, questions/answers (auditory); and activities and outdoor exercises (kinesthetic). This well-rounded approach leads to maximum comprehension and retention. These observations plus our review of training materials such as the BRC Rider Handbook and the ERC Classroom Cards, lead us to conclude that both courses are effective and worthwhile. We were particularly impressed as we watched students who had never been on a motorcycle at the beginning of a BRC course learn to become competent drivers by the end. We were equally impressed by the skill, care, and professionalism of BRC and ERC instructors.

Analyses of Safety Data

Analyses of driver records, training records, and crash records were conducted to answer several specific research questions that collectively elaborate the general theme of whether the PAMSP is effective in creating safer drivers. Data were provided by three sources:

- motorcycle crash records from PennDOT's Bureau of Highway Safety and Traffic Engineering (BHSTE)
- driving records from PennDOT's Bureau of Driver Licensing (BDL)
- training records from the PAMSP

For analysis purposes, the databases of crash, driver, and training records were organized into three data sets, each of which represented a subset of the overall population of interest (i.e., PA motorcycle drivers):

Data Set 1

- included 726,248 drivers with a Pennsylvania license and a Class M-related Business Action Code (MBAC; typically granting or renewing a Class M license or permit) at some point during the period 1990-2007;
- answered questions about whether motorcycle crashes are related to driver attributes such as violations and sanctions.

Data Set 2

- included 282,111 drivers with a Pennsylvania license (of any class) who registered with the PAMSP during the study period;
- answered questions about whether drivers who passed one or more PAMSP courses were less likely to crash on a motorcycle than those who did not take or complete any courses.

Data Set 3

- included 27,762 drivers with a Pennsylvania license (of any class) who crashed as a driver of a motorcycle in Pennsylvania from 1997 to 2007;
- answered questions about relationships among drivers' violation and sanction histories, motorcycle training histories, and characteristics of crashes such as crash severity.

A variety of data analysis techniques were used, including descriptive statistics (frequency distributions, measures of central tendency, variability, and association), logistic regression analyses (to test relationships between the likelihood of a crash and [a] driving records, and [b] PAMSP participation), and covariance structure modeling (to investigate relationships among factors related to crash outcomes). In our opinion, the findings and conclusions of these various approaches to the analyses are robust due to the large samples upon which they are based.

Summary of Major Findings

Key findings of Data Set 1 analyses of driving records:

- aggressive driving (according to records of driving violations) increases the likelihood of a motorcycle crash;
- however, drivers with more violations may simply ride more, increasing crash likelihood due to greater exposure.

Key findings of Data Set 2 analyses of PAMSP records:

- drivers with higher PAMSP knowledge test scores were slightly *less* likely to crash;
- drivers with higher PAMSP skill test scores were slightly *more* likely to crash, probably because they ride more and may be more likely to crash due to greater exposure.

Key findings of Data Set 3 analyses of crashes:

- DUI at time of crash had a greater impact on injury severity than any other contributing factor in a crash, regardless of type of crash or type of motorcycle;
- the strongest influence on DUI at time of crash is the number of DUI convictions on a driver's record;
- drivers who passed a PAMSP course were substantially *less* likely to be DUI than drivers who did not take or pass a PAMSP course;
- inexperienced drivers were somewhat more severely injured than experienced drivers, according to judgments of investigating officers recorded on crash reports;
- speeding drivers were more severely injured than drivers who were not speeding;
- DUI drivers were more likely to speed than non-DUI drivers;
- younger drivers were more likely to speed than older drivers;
- drivers with MBAC were somewhat less severely injured than drivers without MBAC;
- MBAC drivers were substantially less likely to be DUI at time of crash than drivers without MBAC;
- a motorcycle driver can substantially reduce his or her chances of severe injury and death in a crash, by not drinking and riding, not speeding, being properly trained and licensed, and wearing proper and highly visible protective gear;
- information about odds of severe injury in a crash based on individual risk profiles can be used to educate drivers and help them to make better and smarter riding choices.

Strategy Development

Three primary themes underlie our suggestions for improvement strategies and techniques:

- First, the population of Pennsylvania motorcycle drivers is actually several distinct subpopulations that differ from one another along dimensions of driver age and gender, types of motorcycles driven, and past driving records.
- Second, understanding individual crash risk profiles based on factors like age, gender, and past driving record would be beneficial to drivers, to PennDOT, and to others who promote motorcycle safety.

- Third, to effectively address subpopulations of motorcycle drivers and account for their individual risk profiles, PennDOT must have better data concerning individual driving records that pertain to motorcycle driving.

Our improvement strategies are organized in terms of motorcycle driver education and training, program administration, and licensing and enforcement:

Motorcycle Driver Education and Training

- Publicize PAMSP courses and their benefits.
- Expand the PAMSP capacity, with more classes offered to accommodate greater demand due to increased marketing.
- For the BRC and ERC, expand the material devoted to conspicuity, alcohol intoxication, and the hazards of speeding and associated risk of injury and death.
- Develop a self-assessment of crash risk tool and make it available via the PAMSP website, BRC and ERC courses, and other venues as appropriate.
- Consider offering a wider range of PAMSP courses to accommodate experienced motorcycle drivers who wish to improve their skills.
- Require an unlicensed motorcycle driver who is charged with a driving violation to take and pass a PAMSP course, thereby receiving a Class M license, or face a 30-day license suspension.
- Publicize the law and penalties for driving a motorcycle without a proper license/permit.

PAMSP Administration

- Use market segmentation in educational and outreach efforts for motorcycle safety messages, directed toward aspiring motorcycle drivers, drivers without a proper license or permit, drivers unlikely to enroll in a PAMSP course, sport bike drivers, cruiser drivers, novice drivers, and drivers with poor driving records.
- Establish a speakers' bureau to make knowledgeable experts available to motorcycle enthusiast and other interested community groups for presentations on motorcycle safety.
- Expand PennDOT's capabilities for recording and utilizing information stored in driving records concerning motorcycle drivers.
- Track improvements in motorcycle safety using enhanced violation records and crash statistics. Relate these to market segments to determine the effectiveness of safety improvement initiatives by segment.

Licensing and Enforcement

- Work with partners to address unlicensed motorcycle, DUI, and speeding drivers through better enforcement of existing laws.
- Work with partners such that when a motorcycle encounters a checkpoint (of any type) and the driver is found to be improperly licensed, the officer should have available information brochures for licensing and PAMSP training.
- Screen for motorcycle drivers at departmental hearings (speed hearings, young driver hearings, Type II and Type III hearings, etc.). For any driver who committed a DUI, speeding, or reckless driving violation while driving a motorcycle, the examiner should review the driver's record, counsel the driver on safe riding, and present the driver with two options: (a) pass a PAMSP course, or (b) receive a 60-day license suspension.

Introduction

Consistent with national trends, from 2000 to 2007 Pennsylvania's motorcycle crashes increased by 44.6% (PA Legislative Budget and Finance Committee Report, June 2008). Nationwide, deaths from motorcycle crashes have more than doubled in the past dozen years. The National Agenda for Motorcycle Safety Implementation Guide, jointly sponsored by the Motorcycle Safety Foundation (MSF) and the National Highway Traffic Safety Administration (NHTSA), reported that 80% of motorcycle crashes injure or kill a motorcycle driver.[1] Considering these alarming statistics, it is imperative to pursue every possible avenue to increase motorcycle driver safety. One important route begins with an examination of the effectiveness of the Pennsylvania Motorcycle Safety Program (PAMSP). This report describes an evidence-based evaluation that integrates quantitative and qualitative information with a goal of formulating practical strategies and techniques to improve the PAMSP, driver education, and other practices related to motorcycle safety.

The PAMSP, in operation since 1985, is intended to help improve driving habits among motorcyclists by teaching drivers of all experience levels the fundamental knowledge and skills needed to reduce risk and to operate safely. Two courses are offered, a Basic Rider Course (BRC) geared toward beginning motorcycle drivers and an Experienced Rider Course (ERC) that emphasizes advanced skills. Pennsylvania's program conforms to the MSF's training curricula as revised in 2001. Through an evaluation of the effectiveness of the PAMSP and by implementing the improvement strategies and techniques that follow from it, PennDOT endeavors to decrease the number of motorcycle crashes resulting in death or injury.

A literature search on the effects of skill and safety training on subsequent driver behavior was conducted. The literature search addressed such topics as factors implicated in motorcycle crashes, effectiveness of safety training courses, and driver characteristics associated with propensity to engage in unsafe driving behavior. A survey/questionnaire to collect information from other state motorcycle safety programs was conducted. This survey, completed by 25 states, gathered information about their motorcycle safety training programs and licensing practices, and evidence available regarding the effectiveness of these programs and practices.

A series of meetings were held among the researchers, the project Technical Advisor, and other key stakeholders responsible for administering the PAMSP for purposes of planning project activities and reviewing progress. We attended BRC and ERC classes as observers to gain first-hand knowledge of current training practices.

Although evidence-based decisions are central to achieving the stated purpose of evaluating "…whether the MSP is effective in creating safer drivers" (RFQ 06-10 [C01], p. 14), it is important to note the characteristics of the data available and their ability to support valid inferences about driver behavior and training program effectiveness. For example, until recently PennDOT did not measure annual motorcycle miles driven by drivers with Class M licenses. Because of this, it was not possible to calculate the probability of a motorcycle crash for each

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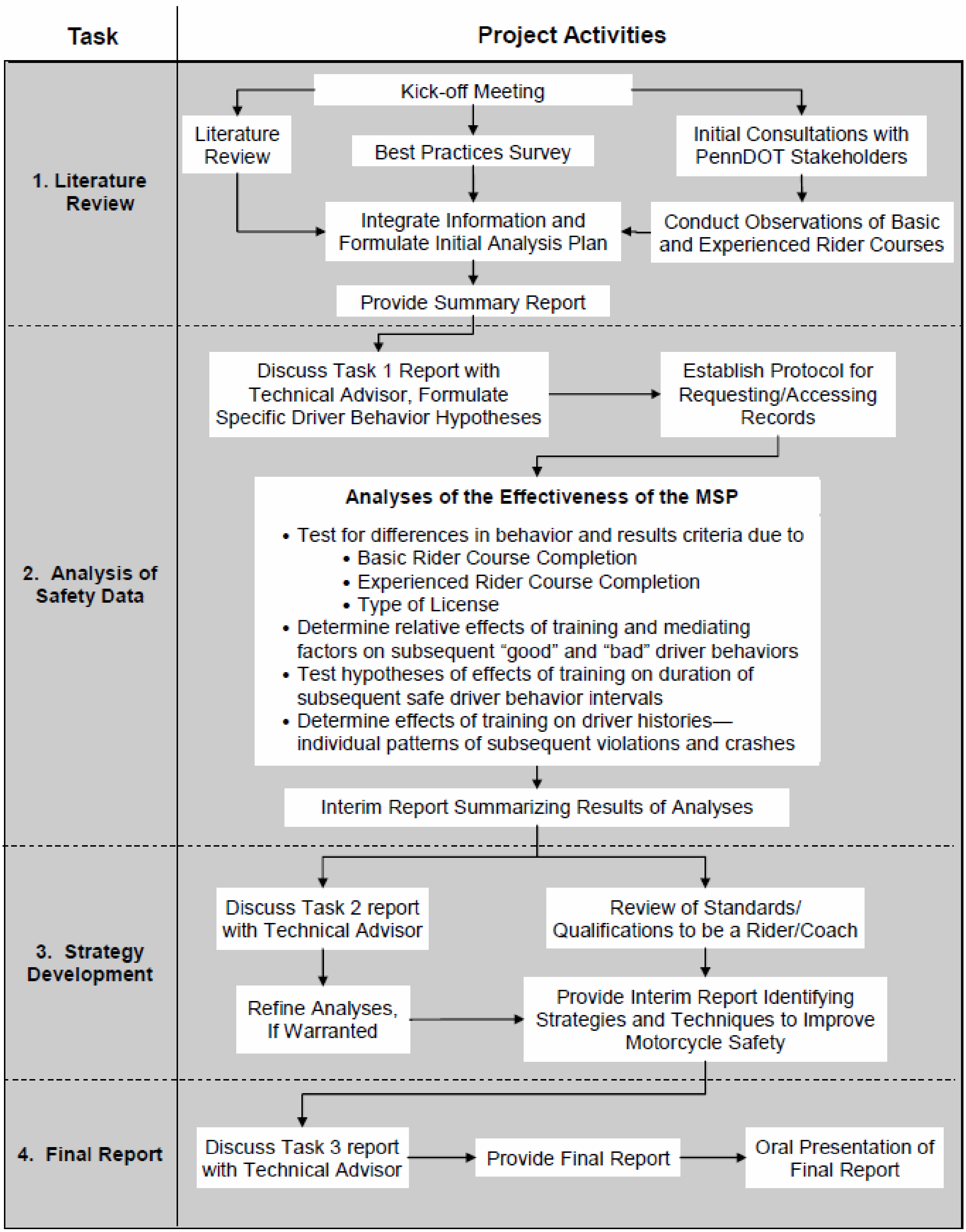
[1] The focus of this research is drivers of motorcycles, rather than passengers. Therefore, the term "motorcycle driver" is generally used rather than "motorcycle rider," to distinguish motorcycle drivers from passengers (because both are riders).

driver relative to the number of miles he or she has driven (what might be called *exposure*). This limited our ability to draw conclusions about factors that affect crash probability. Most of our analyses therefore focused on factors implicated in motorcycle crashes, using data available from crash records.

Crash records provided results criteria that directly relate to PennDOT's overall objectives of increasing roadway safety and reducing crashes and fatalities. Driver records, including individual histories of violations and sanctions, are indicators of safe and unsafe driving habits and can thus be classified as behavior criteria. Crash records *and* driver histories made important contributions to evaluation of the PAMSP and to understanding factors implicated in motorcycle crashes. A number of specific research questions were addressed that collectively elaborated the basic issue of PAMSP effectiveness.

Figure 1 shows the flow of project activities. As described in detail in the task descriptions that follow, several sources of information were brought to bear in evaluating the effectiveness of the PAMSP and formulating strategies and techniques for improvement. These include available literature on causes of motorcycle accidents and factors that influence the success of safety training programs, review of best practices of other state departments of transportation and departments of motor vehicles, interviews and consultations with key stakeholders, observations of current training practices, and analyses of records of motorcycle drivers. In their entirety, these activities informed a set of strategies and techniques for PAMSP improvements and other steps that PennDOT might take to improve motorcycle safety.

Figure 1. Project Plan: Evaluation of Pennsylvania's Motorcycle Safety Program



Task 1: Literature Review

A literature search on the effects of skill and safety training and related factors on motorcycle driver behavior was conducted. This focused on topics relating to this central issue, including:

- Design of safety training courses for motorcycle drivers
- Factors implicated in motorcycle crashes
- Effectiveness of driver skills training programs for various types of vehicles (motorcycles, as well as other types of vehicles)
- Effectiveness of driver safety education programs for various types of vehicles (motorcycles, as well as other types of vehicles)
- Attitude change and safe driving behavior
- Driver characteristics (age, gender, experience) and propensity to engage in unsafe driving behavior

Published and unpublished studies were sought from such literature domains as psychology and human factors, safety and crash prevention, insurance, and law enforcement in domestic and international books and journals. Of particular importance were searches of transportation resources such as the Transportation Research Board's (TRB) TRIS database and for current research, the TRB Research-in-Progress database, and others such as the International Transport Research Documentation database.

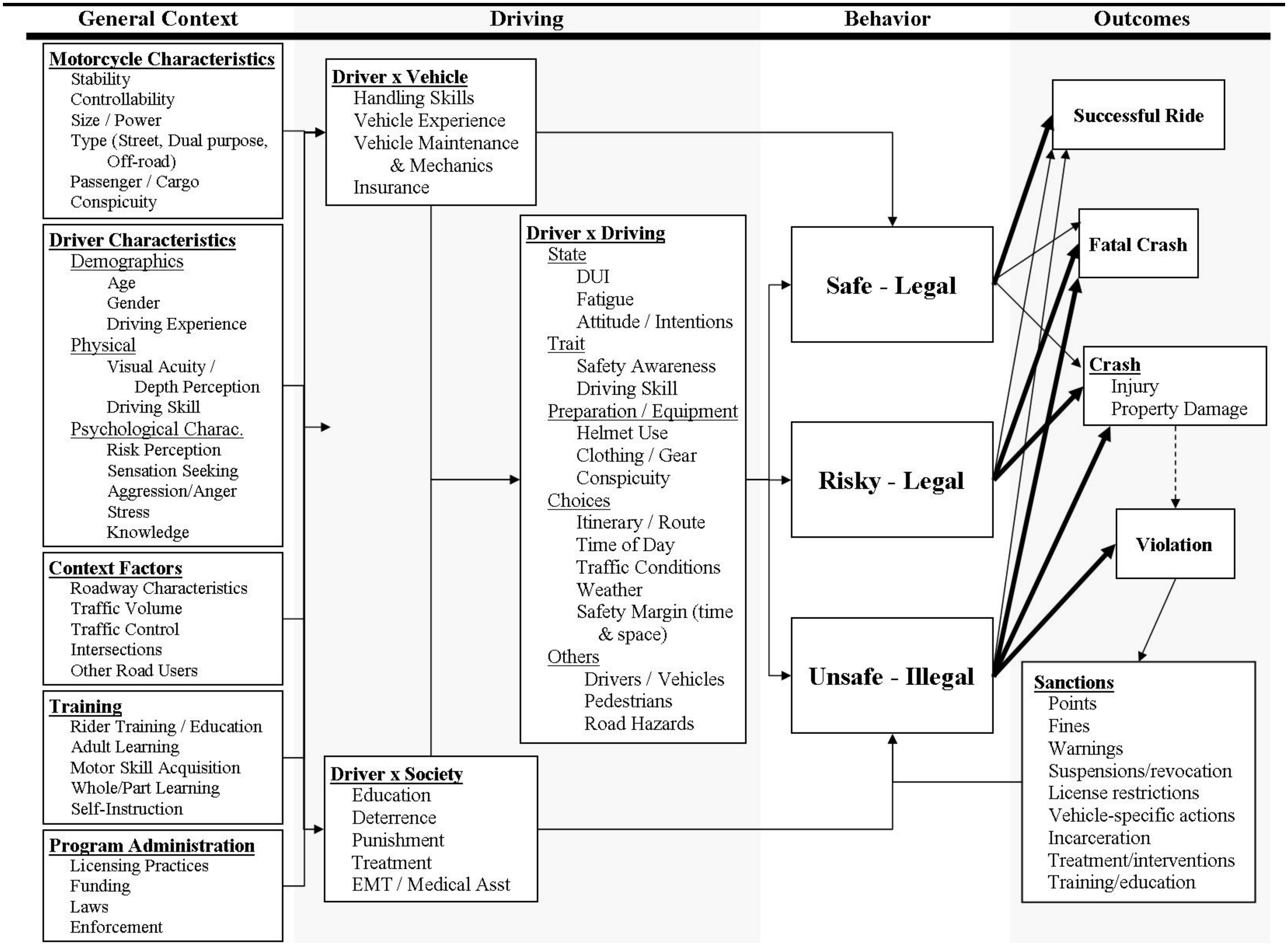
The literature search yielded 350 studies, reports, and citations that were summarized in the *Task 1: Literature Review* report (printed as a separate stand-alone document dated September 5, 2007). This report is organized into three sections:

I. Introduction;
II. Synopsis of Findings: What the Literature Says about Factors Implicated in Risky Driving Behavior, including Motorcycle Driving;
III. Listing of References, Abstracts, and Relevant Topics of Articles and Reports Cited

Figure 2 provides a conceptual model of antecedent factors associated with safe, risky, and unsafe motorcycle riding behavior, and consequences of this behavior. Bold arrows from (a) Safe – Legal behavior to Successful Ride, (b) Risky – Legal behavior to Crash (Injury and Property Damage) and Fatal Crash, and (c) Unsafe – Illegal behavior to Violation, Crash (Injury and Property), and Fatal Crash convey our expectations concerning the relative likelihood of behavior – outcome relationships. Riding in an unsafe and illegal manner increases the likelihood of being cited with a violation. Riding in a risky but legal, *or* unsafe and illegal, manner increases the likelihood of being involved in a crash. Riding in a safe and legal manner increases the likelihood of completing a successful ride. Non-bold arrows from behavior to outcomes acknowledge that each behavior type can yield each outcome type. Unsafe and illegal riding behavior can, and usually does, result in a successful, event-free ride. Safe and legal riding sometimes results in a fatal crash. From a safety improvement perspective, bold arrows relate to the anticipated benefits of efforts to (a) encourage safe riding practices and (b) discourage unsafe practices. The dashed arrow from Injury and Property Damage Crashes to Violations indicates that motorcycle drivers involved in crashes are cited with violations only if they are determined to have engaged in illegal behavior that contributed to the crash.

A survey/questionnaire to collect information from other state motorcycle safety programs was conducted. This survey, completed by 25 states, gathered information about their motorcycle safety training programs and licensing practices, and evidence available regarding the effectiveness of these programs and practices. Appendix A includes the survey and a summary of responses.

Figure 2. Model of Motorcycle Safety



Task 2: Analysis of Safety Data

The basic research question posed by PennDOT is summarized on p. 14 of the RFQ as determining "…whether the training program is effective in preventing fatal crashes or those resulting in injury" and "…whether the MSP is effective in creating safer drivers." Evidence-based answers to these questions require defining the population of interest. The population determines the data that must be gathered to answer the research question.

Defining the Population

There are several possible ways to define the population:

- all motorcycle drivers who have been involved in crashes resulting in injuries or fatalities;
- all motorcycle drivers who have completed either the BRC or ERC;
- all drivers who possess (or have possessed) a Class M license or Class M learner's permit.

The third definition is the broadest in that it encompasses the greatest number of drivers. Because of the logic underlying the analyses proposed below, the broadest definition is preferable. We define the population of interest as all drivers who possess or who have possessed a Class M License and/or Class M learner's permit at any time during the period 1990-2007, plus any driver in possession of a different class of Pennsylvania license or permit who has been involved in a motorcycle crash as a motorcycle driver.

An inclusive definition of the population of interest is dictated by the requirements of research designs to test the effectiveness of the PAMSP. Most fundamental of these is the ability to compare motorcycle drivers who have had safety training to those who have not. The basic research hypothesis is that those who successfully completed safety training are safer drivers and have fewer crashes than those who did not successfully complete training and those who had no training. Testing this hypothesis requires records for all motorcycle drivers, including those who have and have not attended safety training.

Criteria for Training Program Effectiveness

Closely related to the population definition is the issue of the factors or variables on which to compare drivers. Although a crash can be an indicator of unsafe driving, other measures of unsafe driving are available and should be included in a comprehensive study. Driver histories include violations and associated points and sanctions. If a motorcycle driver operates in an unsafe manner, it is likely that evidence of this unsafe driving appears in PennDOT's driver history records. Note that driver records do not indicate the type of vehicle driven at the time of a violation. Thus, the records do not reveal whether a Class M driver with three speeding violations was operating a motorcycle when any or all of those violations occurred. It is nevertheless reasonable to infer that a driver with several violations operates less safely than a driver with no violations; if both drivers possess Class M licenses, safe and unsafe driving habits are probably as true for motorcycle operation as for other types of vehicles.

Any assessment of training program effectiveness requires definition and measurement of one or more effectiveness criteria. Kirkpatrick (1959) provided a well-known typology of four “levels” of training effectiveness criteria: reaction, learning, behavior, and results. These can be ordered along a continuum from individual subjective judgments at one end to organizationally-relevant objective outcome measures at the other (hence the term *levels* of criteria).

- *Reaction* criteria are trainees’ opinions of a training program, whether they liked or disliked it, whether they thought they learned anything of value from it, whether they regarded the instructor as knowledgeable, etc. Reaction criteria are typically measured by attitude questionnaires at or near the end of the course.

- *Learning* criteria are measures of the amount of learning of principles, facts, techniques, skills, and attitudes that were identified as training objectives. There are many ways to measure learning criteria, including paper-and-pencil tests of knowledge, observations and ratings by instructors or others who monitor trainee progress, electronic records of skill acquisition such as proper lane positioning during an exercise in a driving simulator, and so on. Learning criteria are typically measured during and/or upon completion of a training program.

- *Behavior* criteria include measures of “real-world” performance after completion of a training program. Because virtually all training programs are intended to impart valuable knowledge and/or skills, behavior criteria assess post-training performance in the *transfer setting*. Examples include a supervisor’s rating of job performance, successful completion of a new task assignment, and time to achieve an acceptable level of task proficiency. A very broad array of specific behavior criteria is possible; however, all measure aspects of performance that are specifically relevant to training course objectives.

- *Results* criteria relate the results of a training program to organizational objectives. Organizations invest resources in training programs, and results criteria measure returns on those investments. Examples include production costs, efficiency, quality, and error/scrap rates. In designing a training program it is important to identify results criteria that clearly relate to training objectives and that can serve as “bottom-line” measures of training effectiveness.

Crash records provide *results* criteria that directly relate to PennDOT’s overall objectives of increasing roadway safety and reducing crashes and fatalities. Driver histories are indicators of safe and unsafe driving habits and can thus be classified as *behavior* criteria.

Crash records *and* driver histories will make important contributions to a comprehensive evaluation of the PAMSP. These results and behavior criteria are complementary, together yielding a richer evaluation of program effectiveness than either alone could provide. The knowledge and skills tests administered at the completion of the BRC are *learning* criteria. Finally, although *reaction* criteria are measured by student evaluations, we were not provided with these data.

Driver, Training, and Crash Records

During initial consultations with the Technical Advisor we discussed the records available for this population and the specific data these records contain. Driver records (including violations and sanctions) were provided for all Class M and permit drivers since 1990. Records for drivers who registered with the PAMSP since 2004 were provided. Crash records for all drivers who crashed while driving a motorcycle in Pennsylvania between 1997 and 2007 were provided.

We created a database to organize and store all relevant information for each driver. This database facilitated statistical analyses to evaluate the effectiveness of the PAMSP. To perform such analyses, relevant data were coded to create independent and dependent variables for each record. Examples of variables that were coded for each driver include number of sanctions, severity of crash (injuries, fatalities), helmet use, DUI, and type of motorcycle.

Analyses of Motorcycle Safety Program Effectiveness

Analyzing driver and crash records to reach meaningful conclusions about training program effectiveness that support practical and useable improvement strategies and techniques requires a sophisticated analytic approach. Analyses of driver records, training records, and crash records were conducted to answer several specific research questions that collectively elaborate the general theme of whether the PAMSP is effective in creating safer drivers.

Data were provided by three sources:

- motorcycle crash records from PennDOT's Bureau of Highway Safety and Traffic Engineering
- driving records from PennDOT's Bureau of Driver Licensing
- training records from the PAMSP

Each dataset was provided in a unique format.

PennDOT Crash Data

PennDOT's Bureau of Highway Safety and Traffic Engineering (BHSTE) provided copies of eleven years of crash records. A separate Microsoft Access database for each year was provided. These databases were cleansed of identifying information for individual drivers such as name, social security number, address, etc.; only data pertinent to analyses was retained. Once cleansed, queries were run to pull out only those crash records relating to motorcycle crashes and the person driving the motorcycle involved in the crash. A master Motorcycle-Only Crash database was created using these queries.

PennDOT Driver Records Data

PennDOT's Bureau of Driver Licensing provided copies of driver records for all drivers issued a Pennsylvania Class M license or permit since 1990. Separate delimited text files were provided for driver information (e.g., driver license numbers), driving history (e.g., records of convictions for violations and sanctions imposed by PennDOT), and product information (e.g., licenses and permits issued). Processing these data was time consuming since there were about 1.5 million motorcycle license/permit holders included in this dataset, along with their driving histories (another 5.5 million records). All of the text files were imported into both Microsoft SQL Server and Microsoft Access for processing. Since these data were from a legacy system all date fields needed to be converted to analyzable formats. To prepare for analyses, many new variables were created (e.g., total numbers of violations and sanctions per driver, rates of violations and sanctions per unit of time).

PAMSP Training Data

The PAMSP provided a full backup of its Microsoft SQL Server database which included all of the training records since 2004. This database was imported into Microsoft SQL Server, and cleansed of all identifying information for individual drivers. To prepare for analyses, many new variables were created (e.g., total number of rider courses enrolled per driver, number of passing grades, best knowledge and skill test scores for drivers who took multiple courses).

Relating Multiple Databases

Once all three data sources were imported into a single common database, all of the data were related based on driver license numbers, since this is the common unique identifier for a person across all of the databases. Having one common database allowed the creation of even more variables for analysis, such as elapsed time from passing a PAMSP course to crashing while driving a motorcycle, elapsed time from M-license issuance to crashing while driving a motorcycle, etc. The common database also allowed queries to be run to cut the data in many different ways in order to answer the many questions posed of the data. To answer specific questions, the data were exported from the common database and then imported into statistical software packages such as SPSS and LISREL.

Although the general question of whether the PAMSP is effective in creating safer drivers is straightforward, the wealth of data available in driver records affords myriad specific research questions. Each specific question, in turn, posed its own data requirements and analytic approach. For analysis purposes, the database of driver, training, and crash records was organized into three data sets that correspond to the three definitions of the populations of interest described above.

Data Set 1 included drivers with a Pennsylvania license and a Class M-related Business Action Code (MBAC) during the period 1990-2007. A Business Action Code designates an action taken by PennDOT's Driver Licensing Division regarding a driver's record. For our purposes, an MBAC means that the action involved a motorcycle license, generally either granting or renewing an M permit or license. (In fact, a driver may have had more than one MBAC during this period, for example, obtaining an M permit followed by an M license.) We used the MBAC criterion as the best available proxy to identify the population of Pennsylvania drivers who expressed intention to drive a motorcycle (obtained a Class M license or permit). Data Set 1 was used to answer questions about whether motorcycle crashes are related to driver attributes such as violations and sanctions.

Data Set 2 included drivers with a Pennsylvania license (of any class) who registered with the PAMSP during the study period. It is necessary to register to access information about training classes (e.g., schedules and locations of upcoming BRC and ERC classes) and to register for classes. We used PAMSP registration as the best available proxy to identify the population of Pennsylvania drivers who expressed interest in motorcycle safety. Data Set 2 was used to answer questions about whether, among drivers who indicated interest in motorcycle safety, those who actually passed one or more classes were less likely to crash on a motorcycle than those who did not take or complete any classes.

Data Set 3 included drivers with a Pennsylvania license (of any class) who crashed as a driver of a motorcycle in Pennsylvania from 1997 to 2007. Of the three data sets, this in the only one that included drivers who we know for certain actually drove a motorcycle on Pennsylvania roads during the study period. Because all drivers in Data Set 3 crashed on a motorcycle, this data set was used to answer questions about relationships among drivers' violation and sanction histories, motorcycle training histories, and characteristics of crashes such as crash severity.

Analyses of Crash, Training, and Driver Records: Data Set 1

As noted previously, Data Set 1 included drivers with a Pennsylvania license and an MBAC during the period 1990-2007. A total of 726,248 drivers met these criteria. Such a large number of cases increases the computer processing time for analyses; to reduce processing time, a 50% random sample was drawn. Thus, Data Set 1 included 363,124 drivers with an MBAC. Of these, 8,554 drivers crashed as a driver of a motorcycle on Pennsylvania roads during the 11-year period from 1997 to 2007, or 2.4%. A large majority of MBAC drivers (354,570, or 97.6%) did not crash as a driver of a motorcycle.

We do not known what proportion of MBAC drivers ever actually drove a motorcycle during this period; as noted previously, only PennDOT crash records can verify that a driver operated a motorcycle. We suspect that many drivers who possess an MBAC never actually drive a motorcycle. It is therefore probably not correct to conclude that the 354,570 drivers included in Data Set 1 who did not crash on a motorcycle drove their motorcycles safely (i.e., without crashing). With this caveat in mind, we analyzed Data

Set 1 to compare MBAC drivers who crashed to those who did not. Such analyses could provide insights into characteristics of motorcycle drivers who crashed.

Table 1 compares MBAC drivers who crashed on a motorcycle to those who did not in terms of gender, possessing a Class M license (according to driver records as of August 2007), registering with the PAMSP, and passing a PAMSP course. Also shown in Table 1 are comparisons on driving record, including whether or not a driver had incurred one or more of the following during the 1997-2007 period: a sanction (license suspension, special point exam, or hearing), a driving violation, or any specific type of driving violation (license restriction, failure to stop or yield, speeding, improper driving, or DUI).

For each driver attribute, Table 1 shows (a) the breakdown categories for each variable (e.g., males and females), (b) the numbers of drivers observed for each category (e.g., the numbers of males and females), (c) the percentages of drivers who did vs. did not crash for each category, and (d) the correlation between the driver attribute and the crash variable. Just as the overall percentage of MBAC drivers who crashed while driving a motorcycle during the study period was small (2.4%), the percentages of crashers for all breakdown categories were small, ranging from a high of 6.1% of drivers with Improper Driving violations to 0.8% of female drivers. Although small, all of the correlations between driver attributes and crashes are statistically significant.

Each driver attribute reveals something about who among MBAC holders crashed while driving a motorcycle. Comparing the percentages for each variable helps to interpret the correlations. For all driver attributes, the category with a greater likelihood of a crash is listed first. Thus, 2.5% of male MBAC drivers crashed whereas only 0.8% of female MBAC drivers crashed. The significant correlation between gender and crash indicates that the observed difference between males and females is real, as opposed to a chance fluctuation in the data. The same is true for all the driver variables shown in Table 1. Thus, compared to MBAC drivers who did not crash, the likelihood is greater that MBAC drivers who crashed while driving a motorcycle:

- were male;
- possessed a Class M license (according to driver records as of August 2007);
- registered with the PAMSP;
- passed a PAMSP course;
- incurred a PennDOT sanction;
- committed a driving violation;
- committed a license restriction violation;
- committed a failure to stop or yield violation;
- committed a speeding violation;
- committed an improper driving violation;
- committed a DUI violation.

Taken together, these findings suggest that male MBAC drivers with a Class M license who had successfully completed a PAMSP course and who had a record of violations and

Table 1. Comparisons of MBAC Drivers with vs. without Motorcycle Crashes

Driver Attribute		Number of Drivers	Percentage with Crash	Percentage without Crash	Correlation (Crash by Attribute)
Gender	Male	312,861	2.5%	97.5%	.038
	Female	45,511	0.8%	99.2%	
M License	Yes	195,340	2.5%	97.5%	.008
	No	167,784	2.2%	97.8%	
PAMSP Registration	Yes	93,460	3.4%	96.6%	.042
	No	269,664	2.0%	98.0%	
Pass PAMSP Course	Yes	28,588	3.0%	97.0%	.012
	No	334,536	2.3%	97.7%	
Sanction	Yes	3,410	6.0%	94.0%	.023
	No	359,714	2.3%	97.7%	
Driving Violation	Yes	16,637	3.8%	96.2%	.021
	No	346,487	2.3%	97.7%	
License Restriction	Yes	1,846	4.8%	95.2%	.012
	No	361,278	2.3%	97.7%	
Failure to Stop or Yield	Yes	3,807	4.5%	95.5%	.015
	No	359,317	2.3%	97.7%	
Speeding	Yes	12,230	3.9%	96.1%	.019
	No	350,894	2.3%	97.7%	
Improper Driving	Yes	4,202	6.1%	93.9%	.027
	No	358,922	2.3%	97.7%	
DUI	Yes	2,526	5.4%	94.6%	.017
	No	360,598	2.3%	97.7%	

Note. Of 363,124 drivers with an MBAC, 8,554 (2.4%) crashed while driving a motorcycle during the 1997-2007 period. Gender information was missing for 4,753 drivers. All correlations are significant ($p < .001$). The total number of drivers with Driving Violations is less than the sum of the numbers of drivers with specific types of violations because drivers may have committed more than one type of violation.

sanctions were more likely to crash while driving a motorcycle than MBAC drivers without these attributes. To examine these results further, a series of logistic regression analyses were conducted. Logistic regressions properly account for uneven distributions, typical of rare events, where one alternative has many more cases than the other (i.e., fewer than 5% of MBAC drivers crashed, were sanctioned, or committed violations during this period). Summarized in Table 2, these analyses examined the relationships between sets of driver attributes and crashes. By considering the joint effects of several driver attributes simultaneously, a more complete picture of factors that contributed to crash likelihood can be realized.

Driver attributes included in the first analysis (Analysis 1) shown in Table 2 include gender, PAMSP registrations, successfully passing PAMSP courses, driving violations, and PennDOT sanctions. Regression coefficients indicate the magnitude and direction of each attribute's influence on crashes, and associated odds ratios reveal the relative strength of each attribute. Thus, the odds ratio of 4.05 for gender means that males were four times *more* likely to crash than females. Drivers who registered with the PAMSP were about two and one-third times *more* likely to crash than drivers who did not register. Drivers who committed one or more driving violations were about one and one-third times *more* likely to crash than drivers without driving violations. Drivers who incurred one or more PennDOT sanctions were almost two times *more* likely to crash than drivers without sanctions. Drivers who took and passed a PAMSP course were somewhat *less* likely to crash than drivers who did not take (or did not pass) a PAMSP course.

The findings of Analysis 1 shown in Table 2 raise several questions. Males were more likely to crash than females. Although Table 1 reveals that there were far more males with MBACs than females (87.3% of MBAC drivers were male), and one would therefore expect far more males to crash than females, the analyses take the uneven distributions of these variables into account. The odds ratio for gender means that males were four times more likely to crash than females *beyond chance levels.* (The same holds true for the other driver attributes.) There is something about being male that increases the likelihood of a motorcycle crash. As noted previously, we have no independent measure of exposure, or how many miles per year an MBAC driver actually rides a motorcycle (because PennDOT does not measure or record this information). It is possible that the average male rides four times as many miles as the average female, and therefore is four times more likely to crash. Or males may ride more aggressively than females, or are less skilled drivers than females, thereby increasing their crash risk. It remains for additional analyses to investigate these potential explanations to determine whether there is evidence that any or none of them are correct.

If registering with the PAMSP indicates an interest in motorcycle safety, then one would expect that these drivers would be less likely to crash than drivers who do not register. However, the odds ratio for the PAMSP variable reveals that drivers who registered were more than twice as likely to crash as those who did not register. We suspect that in Data Set 1, PAMSP registration acts as a proxy for exposure rather than for interest in safety.

Table 2. Logistic Regression Analyses of Driver Attributes Related to Crashes

Analysis 1		**Driver Attributes**
Driver Attribute	**Coefficient**	**Odds of Crashing**
1. Gender	1.397	Males :: Females **4.05** :: 1.00
2. PAMSP Registration	0.843	Registered :: Not Registered **2.32** :: 1.00
3. Driving Violation	0.316	Has Violation :: No Violations **1.37** :: 1.00
4. Sanction	0.624	Has Sanction :: No Sanction **1.87** :: 1.00
5. Pass PAMSP Course	-0.230	Never Passed :: Passed **1.25** :: 1.00
6. Constant	-5.324	
Analysis 2		**History of Specific Driving Violations**
Driver Attribute	**Coefficient**	**Odds of Crashing**
1. Failure to Stop or Yield	.281	Failure on Record :: None on Record **1.32** :: 1.00
2. Speeding	.234	Speeding on Record :: None on Record **1.26** :: 1.00
3. DUI	.447	DUI on Record :: None on Record **1.56** :: 1.00
4. Improper Driving	.731	Improper on Recrd :: None on Record **2.08** :: 1.00
5. Constant	-3.757	

Note. All coefficients are significant ($p < .001$).

That is, MBAC drivers who actually ride motorcycles may be more likely to register, perhaps as a first step in acquiring a Class M license, than MBAC drivers who do not ride motorcycles. According to this logic, those who register are more likely to ride and more likely to crash, by virtue of greater exposure.

When considered alone, passing a PAMSP course was associated with greater likelihood of a crash (see Table 1). In the context of the regression analysis, however, this variable shows a negative coefficient. These results indicate that passing a PAMSP course *reduces* the likelihood of a crash. This apparent discrepancy in findings can be explained by the fact that one must register with the PAMSP before one can enroll in a course. The regression analysis includes both the PAMSP registration and course variables. By taking both variables into account, the regression analysis reveals that, although MBAC drivers who register with the PAMSP are more likely to crash than those who do not register, probably due to greater exposure, drivers who register *and* pass one or more courses are *less* likely to crash than drivers who register and do not take (or do not pass) any courses. Thus, the regression results provide some evidence that passing a PAMSP course reduces the likelihood of a crash.

The findings concerning driving violations and sanctions are as expected – drivers with a history of violations and sanctions, presumably reckless and aggressive drivers, were more likely to crash on a motorcycle. If drivers who incur sanctions are more frequent or severe violators, then it follows that these drivers would be even more likely to crash on a motorcycle. Supporting this interpretation, the odds ratio is greater for sanctions than for violations.

The coefficients shown in Table 2 (Analysis 1) can be applied to their respective variables in the form of a regression equation. This equation yields predictions of whether a driver crashed, and these predictions can then be compared to actual crash data to determine the *predictive accuracy* of the equation. A driver who is predicted to crash based on his or her standing on the five variables and who actually crashes is a true positive. A driver who is predicted to crash but does not is a false positive. A driver who is predicted not to crash and who does not is a true negative, and a driver who is predicted not to crash and who crashes is a false negative. Of the 8,062 drivers included in Analysis 1 who actually crashed, 3,158 were predicted to crash by the equation, for a true positive rate of 39.2%. Of the 350,310 drivers included in Analysis 1 who did not crash, 74,457 were predicted to crash, for a false positive rate of 21.3%. Thus, although we can accurately classify a substantial portion of crashers based on their standing on these five attributes, this equation also leads us to misclassify many of the non-crashers. Analysis 1 provides some insights into driver attributes associated with crashes, but it is far from a complete explanation of crashes.

Driver attributes included in Analysis 2 shown in Table 2 include the specific driving violations of failure to stop or yield, speeding, DUI, and improper driving. Each contributed significantly to the likelihood of a crash. The fifth violation, license restriction, did not contribute significantly to the regression equation beyond the contributions of the other four violations, and is therefore not included in the equation.

The regression coefficients associated with the four violations are positive, indicating that drivers who committed one or more of each violation were more likely to crash while driving a motorcycle. The largest odds ratio (2.08) is for improper driving, revealing that drivers who committed violations such as improper passing, following too closely, and reckless driving, were twice as likely to crash as drivers not convicted of violations due to improper driving. The odds ratios for DUI (1.56), failure to stop or yield (1.32), and speeding (1.26) also show that drivers convicted of each of these violations were more likely to crash than drivers not so convicted. These findings suggest that drivers who drive aggressively and irresponsibly are more likely to crash on a motorcycle than other drivers. As noted above concerning Analysis 1, it is possible that drivers with more violations on their records simply drive more than drivers with fewer violations, and thus have greater crash likelihood due to greater exposure. Although we consider this alternative explanation to be unlikely, we will return to these alternatives when presenting analyses of Data Set 3.

Analyses of Crash and Training Records: Data Set 2

As noted previously, Data Set 2 included drivers (a) with a Pennsylvania license of any class, (b) who registered with the PAMSP from 2004 to 2007 (the period for which records were provided). One must register to access information about training classes (e.g., schedules and locations of upcoming BRC and ERC classes) and to register for classes. We used PAMSP registration as the best available proxy to identify the population of Pennsylvania drivers who expressed interest in motorcycle safety. A total of 282,111 drivers met these criteria. Because Data Set 2 was used to test questions about relationships between training and crashes, and because we do not know which drivers may have received training prior to 2004, we included in these analyses only drivers with an initial MBAC dated April 1, 2004 and later (i.e., drivers for whom the earliest MBAC on record was after the effective date of the beginning of PAMSP records that were provided). This limited the sample to drivers who were likely to have begun driving a motorcycle at about the time they registered with the PAMSP. This yielded a sample of 79,879 drivers, of whom 1,678 (2.1%) crashed as a driver of a motorcycle on Pennsylvania roads during the study period of 1997 - 2007. A large majority of these crashes (97.3%) occurred after April 1, 2004, thus supporting our assumption that most of these drivers were probably not driving a motorcycle before April 2004.

We analyzed Data Set 2 to compare MBAC drivers who registered with the PAMSP to determine whether training is related to crashes. Table 3 compares drivers who crashed on a motorcycle to those who did not in terms of whether they ever registered for a PAMSP course, number of PAMSP course registrations, whether they registered for a BRC, whether they registered for an ERC, and whether they passed a PAMSP course. For those who took a course, drivers are compared on Knowledge and Skill Test Scores.

For each driver attribute, Table 3 shows (a) the breakdown categories for each variable (e.g., registered for a PAMSP course, yes or no), (b) the numbers of drivers observed for each category (e.g., the numbers who did vs. did not register), (c) the percentages of drivers who did vs. did not crash for each category, (d) the correlation between the driver attribute and the crash variable, and (e) for statistically significant correlations, odds ratios (odds of a crash for one category vs. the other).

Whether or not drivers registered for PAMSP courses, or registered specifically for BRC, was not significantly related to crashes. As shown in Table 3, the percentages of drivers who crashed were very similar for drivers who did vs. did not register for these courses. However, statistically significant relationships were found between crashes and number of PAMSP course registrations, ERC registrations, and whether or not a driver actually passed a PAMSP course. Results show that drivers who registered for two or more courses, who registered specifically for an ERC, and who passed a course were more likely to crash than drivers who did not. These correlations are very small, as are the associated odds ratios – drivers who registered for and passed PAMSP courses were only slightly more likely to crash than drivers who did not. However small, these differences are in the opposite direction to what one might expect.

The correlations of test scores with crashes, and associated odds ratios, were also very small and in opposite directions. As might be expected, drivers who achieved higher scores on the PAMSP knowledge tests were slightly *less* likely to crash than drivers who scored lower. Counter-intuitively, drivers who achieved higher PAMSP skills test scores were slightly *more* likely to crash than drivers who scored lower.

Taken together, Data Set 2 findings provide scant evidence for beneficial effects of PAMSP training. As noted in the discussion of the results of analyses of Data Set 1, there is no measure of driving exposure apart from crash data. We suspect that the Data Set 2 variables that correlated positively with crashes, particularly ERC Registration and Skills Test Scores, are proxies for amount of exposure. Drivers who sign up for the ERC, and drivers who demonstrate higher levels of riding skill, are probably drivers who ride more. They are more likely to crash due to greater exposure rather than to lack of skill.

Note that results of Data Set 1 analyses revealed that drivers who registered with the PAMSP and passed a course were slightly *less* likely to crash than drivers who neither registered with the PAMSP nor passed a course. Data Set 2 analyses found that drivers who registered with the PAMSP and passed a course were slightly *more* likely to crash than drivers who registered and did not pass a course. This apparent discrepancy in findings can be explained by the differences in inclusion criteria for Data Sets 1 and 2. For Data Set 1, drivers who passed a PAMSP course were compared to drivers who did not register with the PAMSP and did not pass a course. For Data Set 2, all drivers registered with the PAMSP – the comparison is between those who passed a course and those who did not. It appears that Data Set 1 drivers who registered with the PAMSP and passed a course were more safety conscious and less likely to crash than drivers who did not register or pass a course. Following this logic, Data Set 2 drivers indicated their safety consciousness by registering with the PAMSP – those who passed a course were more likely to crash than those who did not pass a course, probably due to greater driving exposure. These alternative explanations will be investigated further in analyses of Data Set 3.

Table 3. Comparisons of PAMSP Registration Drivers with vs. without Motorcycle Crashes

PAMSP Activity		Number of Drivers	Percentage with Crash	Percentage without Crash	Correlation (Crash by Attribute)	Odds of Crashing
PAMSP Course Registration	Yes	74,808	2.1%	97.9%	.001	
	No	5,071	2.0%	98.0%		
Number of PAMSP Course Registrations	0	5,071	2.0%	98.0%	.008	2+ :: 0 or 1 **1.12** :: 1
	1	54,714	2.0%	98.0%		
	2+	20,094	2.3%	97.7%		
BRC Registration	Yes	73,268	2.1%	97.9%	-.004	
	No	6,611	2.3%	97.7%		
ERC Registration	Yes	3,451	3.3%	96.7%	.018	Yes :: No **1.65** :: 1
	No	76,428	2.0%	98.0%		
Pass PAMSP Course	Yes	51,087	2.2%	97.8%	.011	Yes :: No **1.17** :: 1
	No	28,792	1.9%	98.1%		
Knowledge Test Score	High	34,392	2.0%	98.0%	-.010	Low :: Hi **1.16** :: 1
	Low	19,060	2.3%	97.7%		
Skills Test Score	High	23,377	2.8%	97.2%	.034	Hi :: Low **1.60** :: 1
	Low	29,614	1.7%	98.3%		

Note. Of 79,879 drivers with an MBAC after 4/1/2004, 1,678 (2.1%) crashed while driving a motorcycle during the 1997-2007 period; 97.3% of these crashes occurred after 4/1/2004. Correlations between crashes and PAMSP Course Registration and BRC Registration are not statistically significant; all other correlations are significant ($p < .01$). Odds ratios are not shown for non-significant correlations.

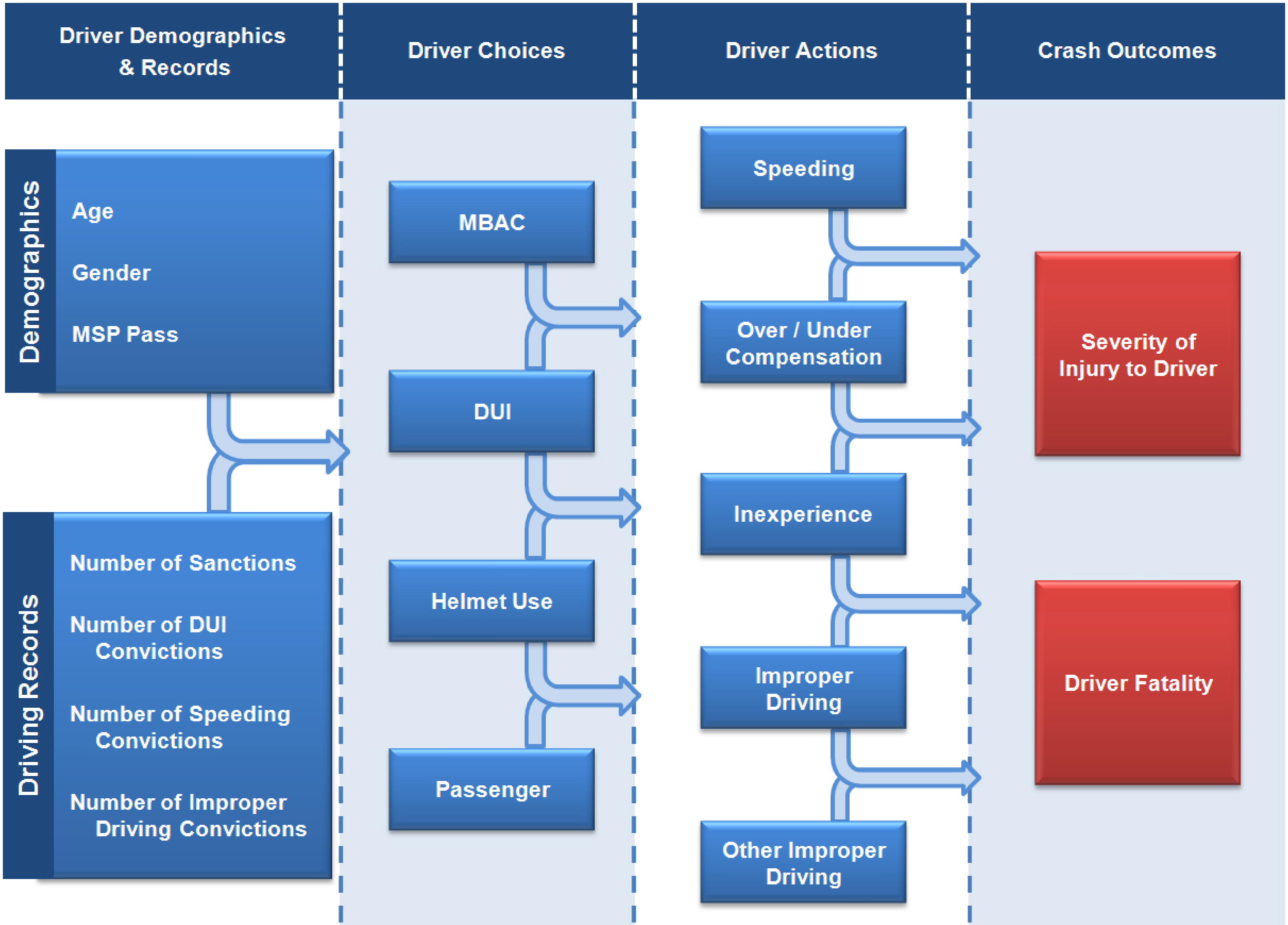
Analyses of Crash and Training Records: Data Set 3

As noted previously, Data Set 3 included drivers with a Pennsylvania license (of any class) who crashed as a driver of a motorcycle in Pennsylvania from 1997 to 2007. If a driver had more than one motorcycle crash during this period, only the first crash was included and analyzed in Data Set 3. Only first crashes were included because 5% of first crashes are fatal to motorcycle drivers; including subsequent crashes in the data set would potentially introduce bias because a sample that included second and later crashes would necessarily over-represent drivers who survived their earlier crashes. Application of these inclusion criteria yielded a sample of 27,762 Pennsylvania drivers who crashed on a motorcycle on a Pennsylvania road from 1997 to 2007.

Of the three data sets, this in the only one that included drivers who we know for certain actually drove a motorcycle during the study period. Because all drivers in Data Set 3 crashed on a motorcycle, this data set was used to answer questions about relationships among drivers' violation and sanction histories, motorcycle training histories, and characteristics of crashes such as injury severity.

Analyses of Data Set 3 included descriptive statistics, cross-tabulations, linear and logistic regression analyses, and covariance structure modeling (CSM). Figure 3 provides a graphic display and a conceptual organization of many of the variables that were analyzed in Data Set 3. Beginning on the right side of the figure, two Crash Outcomes are listed: severity of injuries to the motorcycle driver, and driver fatalities. The second portion from the right of the figure lists Driver Actions, including speeding, over- or under-compensation at a curve, inexperience in operating a motorcycle, improper driving (actions such as tailgating, improper passing, etc.), and other improper driving (the latter is an option on crash report forms, apparently used as a catch-all option). The second portion from the left of the figure lists Driver Choices, including whether a driver had an MBAC, whether the driver was DUI (blood alcohol content of .08 or greater) at the time of the crash, whether the driver was wearing a helmet, and whether a passenger was present. The left portion of Figure 3 lists factors antecedent to the crash, including Driver Demographics and Driving Records. Driver Demographics include driver age at the time of the crash, gender, and whether the driver has passed a PAMSP course. Driver Records include number of PennDOT sanctions incurred, number of DUI convictions, number of speeding convictions, and number of improper driving convictions.

Figure 3. Factors Related to Motorcycle Crash Outcomes



Frequency Distributions of Data Set 3 Variables

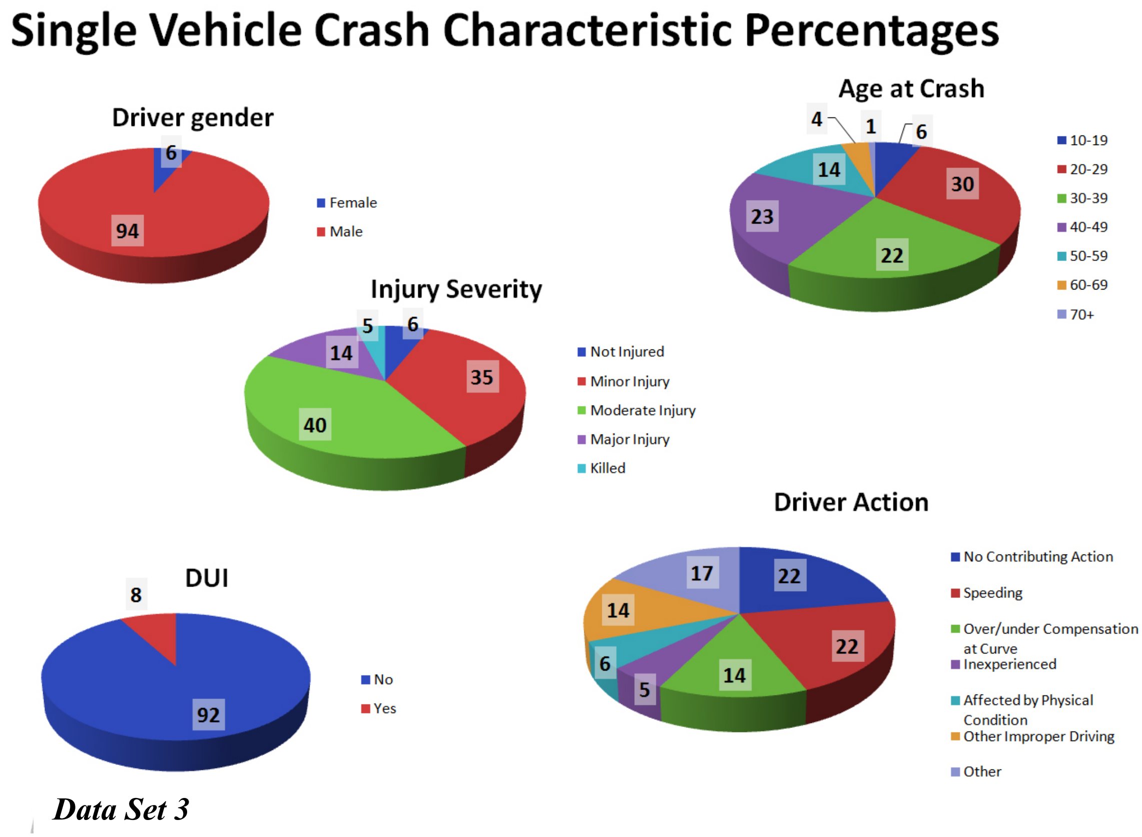
There are many ways to analyze this complex data set. Preliminary analyses revealed that several breakdowns are particularly important. These are: (a) whether the crash was a single or multiple vehicle crash; (b) the type of motorcycle driven (sport/street bike, cruiser, dual sport, off-road, scooter-moped, mini-bike, or unknown); and (c) whether the crash occurred before or after April 2004 (the earliest date for which PAMSP records were provided). Analyses typically involved subsets of the variables shown in Figure 3, with comparisons according to one or more of the breakdown variables.

Figure 4 illustrates selected single and multiple vehicle crash characteristics. Of 27,762 crashes, 13,025 (47%) were single vehicle crashes and 14,737 (53%) were multiple vehicle crashes. Some differences in crash characteristics are noteworthy. A greater proportion of motorcycle drivers involved in single vehicle crashes were DUI (8% single vs. 3% multiple). Drivers in multiple vehicle crashes were much more likely to be reported as making no contributing action (56%) than drivers in single vehicle crashes (22%). Drivers in single vehicle crashes were more likely to be reported as speeding (22%), over-/under-compensating at curve (14%), and other improper driving (14%) than drivers in multiple vehicle crashes (speeding, 9%; over-/under-compensating at curve, 1%; other improper driving, 6%).

Figure 5 illustrates selected sport bike and cruiser crash characteristics. Of 27,762 crashes, 5,129 (18.5%) were sport bike crashes and 13,216 (47.6%) were cruiser crashes. Some differences in crash characteristics are noteworthy. A greater proportion of cruiser drivers were DUI (7% cruiser vs. 3% sport bike). Cruiser drivers were older (79% were between the ages of 30 and 59) than sport bike drivers (70% were under age 30). Cruiser drivers were more likely to be reported as making no contributing action than sport bike drivers (45% vs. 35%). Cruiser drivers were less likely to be reported as speeding than sport bike drivers (11% vs. 21%).

PennDOT provided data for many more variables than could be included in the covariance structure models that were tested using Data Set 3. Frequency distributions are shown in Appendix B for variables obtained from crash records, Appendix C for variables obtained from PAMSP records, and Appendix D for variables obtained from driver records.

Figure 4. Single and Multiple Vehicle Crash Characteristics



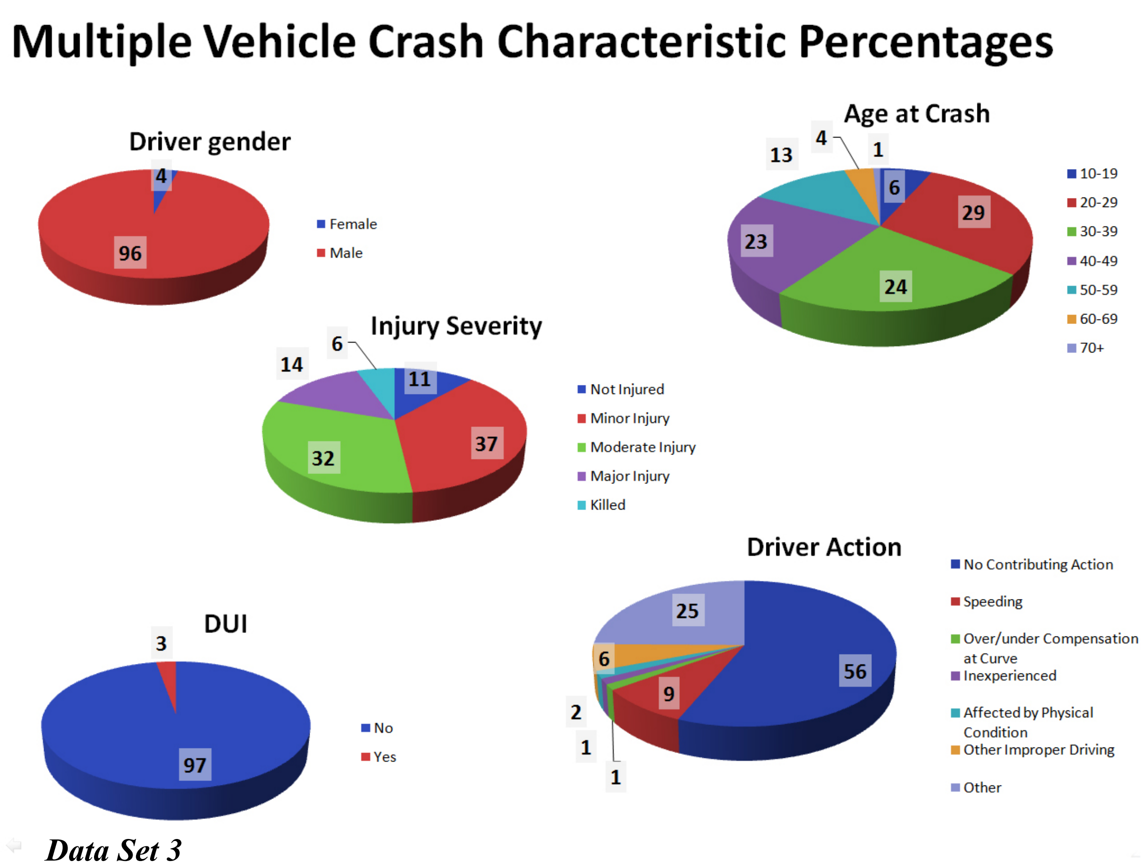
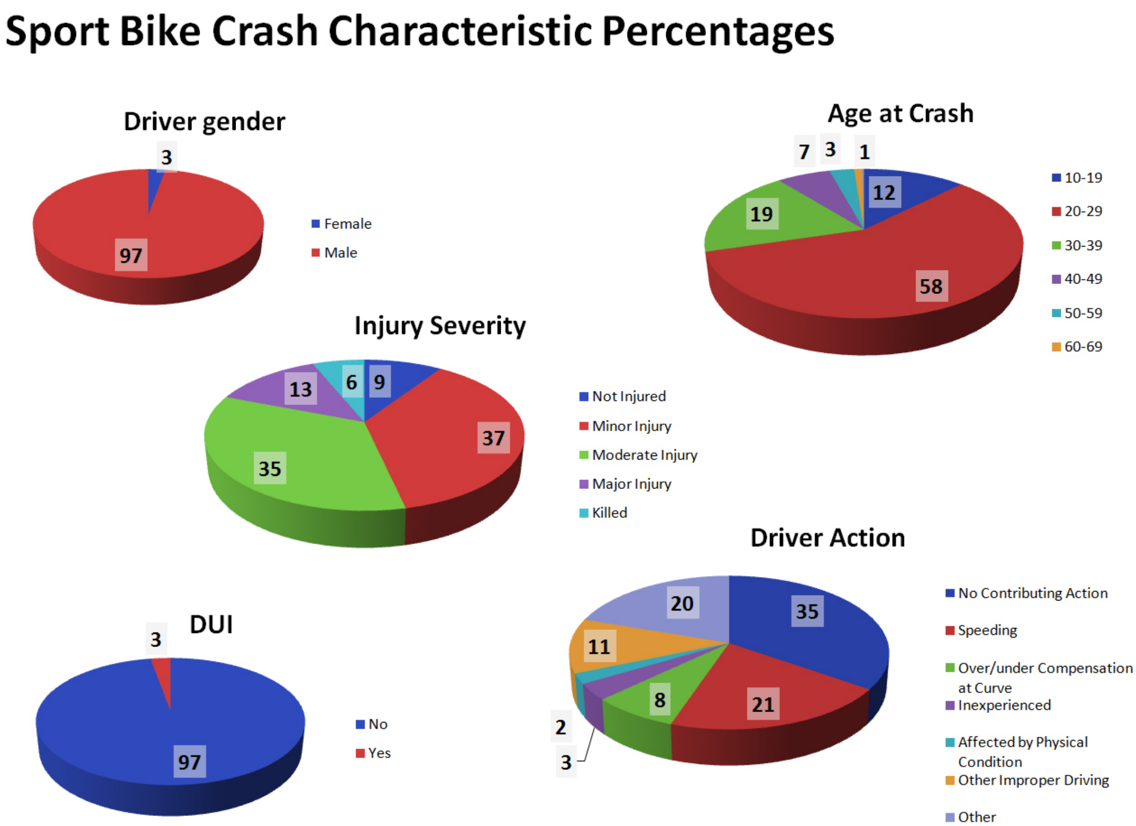
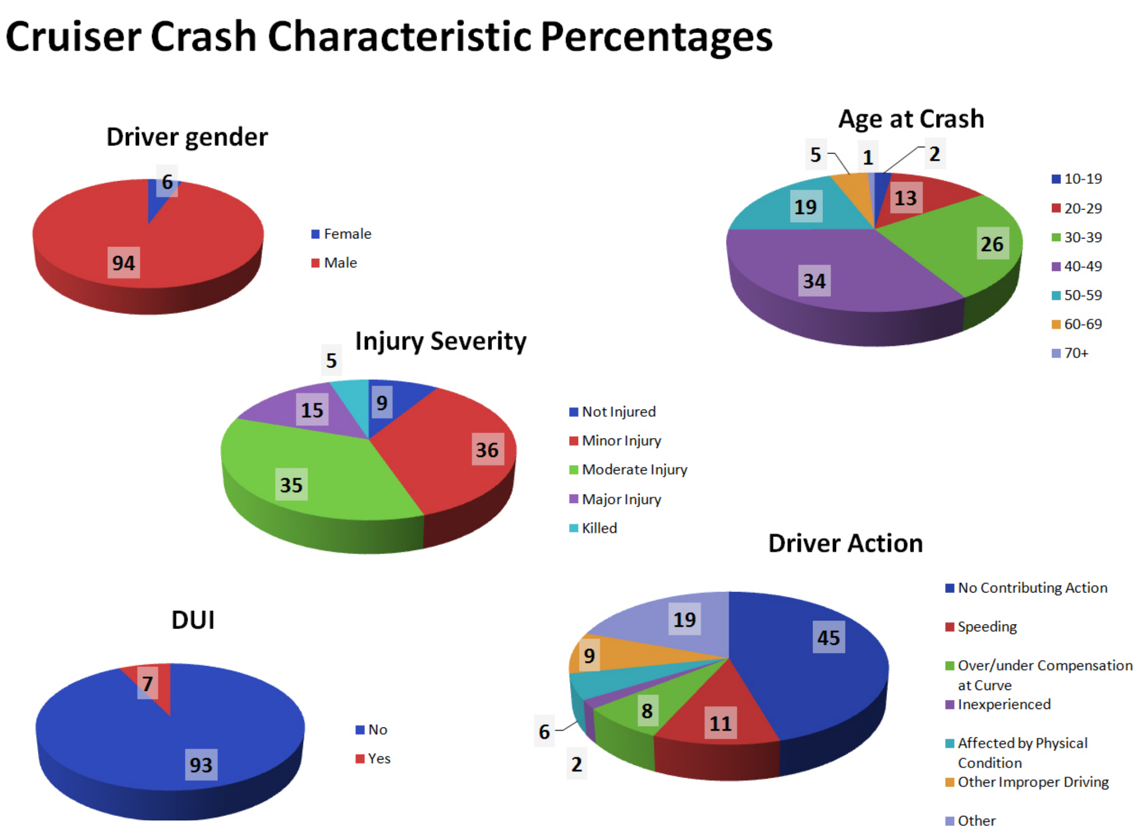


Figure 5. Sport Bike and Cruiser Crash Characteristics



Data Set 3



Data Set 3

Colder Months and Motorcycle Crashes

A variable that was not used in Data Set 3 analyses but that may be informative to PennDOT is month in which a motorcycle crash occurred. Figure 6 shows charts for the months of October, November, December, January, and February. Each chart displays data for that month in each of 11 years, 1997-2007, along the x-axis. The y-axis on the left provides a scale for the number of motorcycle crashes (the vertical bars) that occurred each year, and the y-axis on the right provides a scale for the average daily temperatures (the line graph) each year. Scale values vary from chart to chart to conform to the ranges of values shown. Average monthly temperatures were calculated from average daily temperatures obtained from a website provided by the University of Dayton: http://www.engr.udayton.edu/weather/citylistUS.htm. Harrisburg was used to represent the state of PA.

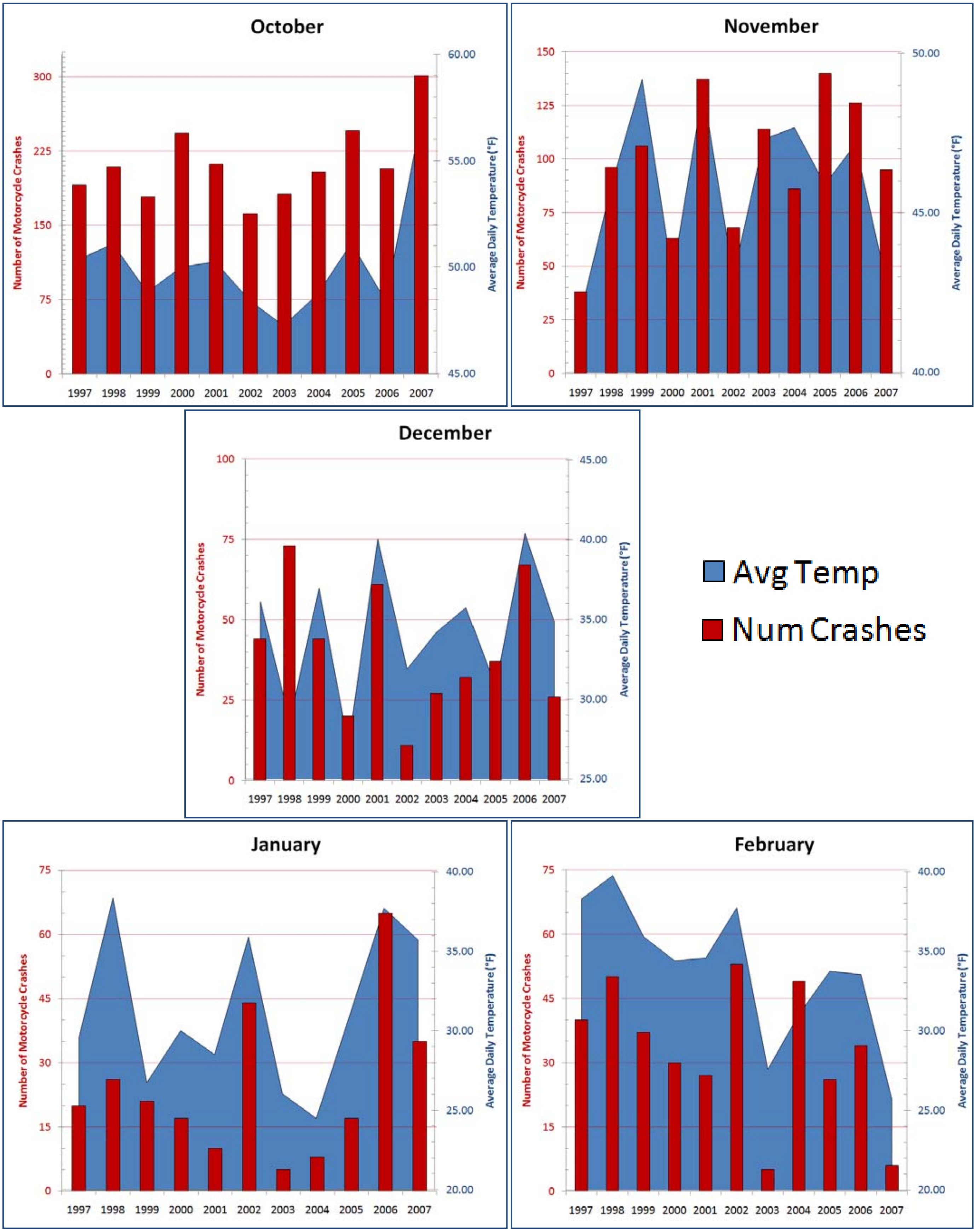
The charts show that fluctuations from year to year in the number of motorcycle crashes during the colder months are related to average monthly temperatures. For the month of January, for example, the years with the warmest temperatures (1998, 2002, 2006, 2007) also had the most crashes, and the years with the coldest temperatures (2003, 2004) had the fewest crashes. Comparing a warm winter to a cold winter, the months of December 2001, January 2002, and February 2002 had an average daily temperature of 37.9 degrees and a total of 158 crashes; the months of December 2002, January 2003, and February 2003 had an average daily temperature of 28.5 degrees and a total of 21 crashes. Thus, a warm winter had about 7.5 times more motorcycle crashes than a cold winter. This explains some of the year-to-year variability in numbers of motorcycle crashes and fatalities. Warmer weather months (March to September) do not show significant correlations between average monthly temperatures and numbers of motorcycle crashes. To minimize the influence of annual fluctuations in average temperatures on motorcycle crash statistics, it may be advisable to calculate and compare crash data only for warmer weather months.

Coding of Variables Used for Data Set 3 Analyses

For some variables, the data supplied by PennDOT were recoded to create variables suitable for analysis.

Driver Injury Severity and Fatality. Injury severity is coded on crash report forms with 7 alternatives: 0 = not injured, 1 = killed, 2 = major injury, 3 = moderate injury, 4 = minor injury, 8 = injury/unknown severity, 9 = unknown. For analysis purposes, this variable was recoded as an ascending 5-point scale: 1 = not injured, 2 = minor injury, 3 = moderate injury, 4 = major injury, 5 = killed (values of 8 and 9 were coded as missing). See Table B1, Appendix B, for frequencies of Injury Severity. Motorcycle driver fatality was also recoded from this variable: 0 = not killed, 1 = killed. See Table B2, Appendix B, for frequencies of Driver Fatalities.

Figure 6. Colder Months and Motorcycle Crashes



Driver Actions. Crash records include fields for coding driver actions that may have contributed to the crash. Crash report forms completed by investigating officers provide 4 fields for recording contributing driver actions, with 32 codes for specific actions (e.g., 08 = running stop sign, 11 = tailgating, 23 = speeding). Because of the number of driver action codes, and because many of these were used infrequently (see Appendix B, Tables B44 – B47), driver actions were combined and recoded into one of six dichotomous driver action variables: Speeding (codes 23 and 24); Over- or Under-compensation at Curve (code 22); Driver Inexperienced (code 27); Affected by Physical Condition (code 92); Other Improper Driving Actions (code 98); and Improper Driving Actions (codes 1 to 21, 25, 26, and 28). A given contributing action such as Driver Inexperienced was coded as implicated in the crash (1 = Yes) if it was recorded in any of the four driver action fields, and coded as not implicated (0 = No) if it was not recorded in any of these fields. See Tables B5 – B10, Appendix B, for frequencies of recoded driver action variables.

DUI. The crash records show alcohol test results. A related variable indicates whether the investigating officer suspected that a driver was intoxicated (alcohol, medication, and/or illegal drugs). If alcohol was suspected and a test was administered, the test result is given. Alcohol was suspected in 3,019 cases out of 27,762 crashes, or 10.9%. Alcohol test results were available for 2,453 of these, showing values ranging from 0 to .74. A DUI variable was created from the test results variable, such that drivers with alcohol test results of 0 to .07 were coded as 0 = Not DUI, and drivers with alcohol test results of .08 to .74 were coded as 1 = DUI. In addition, drivers who were involved in crashes who did not have a test result (most of whom were not suspected of intoxication by investigating officers) were coded as 0 = Not DUI. For analysis purposes, 1,447 drivers were coded as DUI, or 5.2% of the crashes, and 26315 drivers were coded as Not DUI, or 94.8% of the crashes. See Table B4, Appendix B, for frequencies of DUI.

Motorcycle Type. PennDOT crash records include data fields for Vehicle Make (Harley-Davidson, Kawasaki, Suzuki, etc.), Vehicle Type (Motorcycle, Automobile, SUV, etc.), Body Type (Motorcycle, Moped, Mini-bike or Motor Scooter), VINA Body Type (Road/Street Bike, Motor Scooter, Dirt Bike, etc.), Motorcycle Engine Size (in cubic centimeters), and Model Year. Based on information in these fields, plus other relevant information obtained from online research, a Motorcycle Type variable was created with seven alternatives: 1 = Sport/Street Bike; 2 = Cruiser; 3 = Dual Sport Bike; 4 = Off-road Bike; 5 = Scooter/Moped; 6 = Mini-bike; 9 = Unknown Bike Type. These motorcycle types correspond to types described in the Motorcycle Safety Foundation Basic RiderCourse® Rider Handbook (2005). The Unknown Bike Type code was assigned when relevant information needed to make a determination was missing, such as engine size or model year, or when a determination could not be made, according to the available data, because a manufacturer produced more than one type of motorcycle with the same characteristics (e.g., Kawasaki produced sport bike, cruiser, and off-road cycles with 250cc engines in 2001). See Table B15, Appendix B, for frequencies of Motorcycle Type.

Class M-related Business Action Code (MBAC). A Business Action Code designates an action taken by PennDOT's Driver Licensing Division regarding a driver's record. For our purposes, an MBAC means that the action involved a motorcycle license, generally either granting or renewing an M permit or license. (In fact, a driver may have had more than one MBAC during this period, for example, obtaining an M permit followed by an M license, or successive M permits.) PennDOT provided a data file containing the driving records of all drivers involved in a crash from 1997 – 2007 whose records included an MBAC. A variable was created to indicate an MBAC at some point for these drivers (MBAC = 1; 24,769 drivers, or 89.2%); other drivers who crashed were coded as no MBAC (MBAC = 0; 2,993 drivers, or 10.8%). See Table B13, Appendix B, for frequencies of MBAC.

Records of Driving Violations. Driver records include a large number of specific violation codes (more than 800). To reduce these myriad codes to a manageable number of violation types, for the purposes of this project the researchers categorized them into five categories of driving violations: License Restriction, Failure to Stop/Yield, Speeding, Improper Driving, and DUI. To create these categories, the researchers discussed similarities and differences among violation codes and code descriptions, and identified a preliminary set of violation categories. Two of the researchers (Renz and Vance) independently categorized all violations, resolving coding discrepancies by discussion. An Excel spreadsheet summarizing violation categories was then provided to Scott Shenk, the project's Technical Advisor, who reviewed and revised the categories and violation code assignments as needed. The final violation categories, violation codes assigned to each, and violation descriptions are listed by category in Appendix E. See Tables D2 – D5, D10, Appendix D, for frequencies of numbers of driving violations.

Records of Driver Sanctions. Driver records include sanctions that PennDOT administers to drivers as a result of particular violations or point totals. A driver incurs points for each violation, and accumulated points trigger sanctions. Sanctions include license suspensions, 6-point exams (tests of driving knowledge that a driver must pass when the point total first reaches 6 or more points), Type II hearings (administered by a PennDOT examiner when a driver's point total reaches 6 for the second time), Type III hearings (administered by a PennDOT examiner when a driver's point total reaches 6 for the third time), speed hearings (administered when a driver is convicted of exceeding the posted speed limit by more than 30mph), and young driver hearings (administered to 16 and 17 year old drivers). Hearings often result in suspensions, although other penalties are possible, such as license revocation or loss of particular privileges (e.g., CDL HAZMAT certification). For analysis purposes, the number of PennDOT sanctions was calculated for each motorcycle driver involved in a crash between 1997 and 2007. Values ranged from 0 for 14,917 (60.2%) of these drivers, to 166 for 1 driver (0%). See Tables D7, D8, D17, and D19, Appendix D, for frequencies of numbers of PennDOT sanctions.

Profiles of Typical Motorcycle Drivers

Before presenting complex statistical models that tested relationships among crash factors shown in Figure 3, we summarize characteristics of typical motorcycle drivers involved in non-fatal vs. fatal crashes. Characteristics of these drivers and their crashes are shown in Appendix F in pairs of profiles (Profiles 1 - 16) comparing non-fatal vs. fatal crashes for males, females, sport bike drivers, cruiser drivers, unknown bike type drivers, drivers without an MBAC, drivers who passed a BRC between 2004 and 2007 (BRC Pass), and drivers who passed an ERC between 2004 and 2007 (ERC Pass). "Typical" characteristics listed for each profile were determined by examination of frequency distributions of variables for cases selected according to the breakdown criteria (i.e., males, females, sport bike drivers, etc.). For categorical variables, such as gender and license class, modal values (i.e., the most common values) are listed. For continuous variables, such as age and engine size, median values (i.e., the mid-points of the distributions) are listed.

Many of the characteristics of drivers described within pairs of profiles, comparing non-fatal to fatal crashes, are the same or similar. For example, typical males in non-fatal vs. fatal crashes (Profiles 1 & 2) were of the same age and height, and drove motorcycles that differed by only one model year. Differences between non-fatal and fatal male crashers were more pronounced in terms of several other variables, however, including location (fatal crashes were nearly evenly split between urban and rural areas, whereas non-fatal crashes were predominantly urban), time of day (fatal crashes were almost one hour later in the afternoon than non-fatal crashes), number of vehicles involved (fatal crashes were more likely to involve 2 vehicles, non-fatal crashes were nearly evenly split between 1 and 2 vehicle crashes), and collision type (fatal crashes were more likely to involve a DUI driver hitting a fixed object). These comparisons suggest that rush hour traffic conditions (close to 5:00pm, involving 2 vehicles) contribute to fatalities among male drivers.

Typical female drivers in non-fatal vs. fatal crashes (profiles 3 & 4) were of similar ages, but females in fatal crashes were 2 inches shorter than females in non-fatal crashes, and drove motorcycles with larger engines (900cc vs. 700cc). Fatal crashes for females were more likely to involve 2 vehicles in head-on collisions resulting from poor lane position control (driving on the wrong side of the road and/or over/under-compensating on a curve). These comparisons suggest that driver-motorcycle "fit" may be a factor in fatalities among female drivers, and perhaps male drivers. That is, a shorter stature person may be less able to handle and control a larger and/or more powerful motorcycle, particularly under challenging roadway and traffic conditions.

Comparisons can also be made across driver classifications. For example, for fatal crashes, a typical female driver was 6 years older and 7 inches shorter than a typical male driver, and crashed 1.5 years sooner after initial MBAC. Comparisons of sport bike, cruiser, and unknown bike type drivers revealed that sport bike drivers were much younger than cruiser drivers (25 vs. 42 years old). Typical drivers without MBAC involved in fatal crashes were younger (27 years old) and more likely to be DUI at the time of the crash than other drivers profiled. Drivers with BRC pass in fatal crashes were older than BRC pass drivers in non-fatal crashes (39 vs. 32 years old), had more convictions for driving violations (2 or more vs. 1), and were less likely to have worn a helmet at the time of the crash.

Comparisons of profiles of typical drivers involved in motorcycle crashes are interesting, but only suggestive of possible explanations for crash outcomes. Although these profiles are based on large numbers of cases (with the exception of females in fatal crashes, with 22 cases), they are descriptive summaries and as such do not explicitly test the relationships that comparisons among them might suggest. To investigate relationships among crash factors and outcomes, a series of models were tested. These are described next.

Covariance Structure Models of Crash Outcomes

Multivariate data analysis techniques such as covariance structure modeling (CSM) examine the simultaneous effects of multiple independent variables on multiple dependent variables. With such an analysis one can ask, for example, whether training, driver age, gender, drug/alcohol intoxication, helmet use, number of driving violations, and number of PennDOT sanctions affect crash severity. Because multivariate analyses test several independent-dependent relationships simultaneously, results can be interpreted in terms of relative strength of influences, which makes them more valuable than a series of univariate analyses. With multivariate analyses a researcher can also test whether there are *intervening variables* that may affect the relationships between independent and dependent variables. An example of an intervening variable could be helmet use. A hypothetical finding of an intervening variable might be if PAMSP training were found to be particularly effective in encouraging helmet use *and* if helmet use were also found to play a role in crash survival.

Two series of CSM analyses were conducted. Tables 4a through 4e list the Series 1 models. Series 1 included 56 models tested using crash records from 1997 through 2007 (Data Set 3). Only first crashes by a motorcycle driver with a Pennsylvania license (of any class) were included in Series 1 analyses. Tables 5a through 5e list the Series 2 models. Series 2 included 40 models tested using crash records from 2004 through 2007 (the PAMSP subset of Data Set 3). We were provided PAMSP records that spanned 2004 – 2007, and we therefore included only Pennsylvania motorcycle drivers with an initial MBAC date during this period in Series 2 analyses.

CSM analyses were conducted using the statistical software programs PRELIS 2.8 and LISREL 8.8 (Joreskog, K., & Sorbom, D., 2007, Scientific Software International, Inc.). Because some of the variables analyzed in these models were dichotomous with uneven distributions (e.g., driver fatality with 95% non-fatal, 5% fatal; DUI with 94.8% not DUI, 5.2% DUI), others were continuous with highly skewed distributions (e.g., number of DUI convictions, number of speeding convictions), and still others were continuous with approximately normal distributions (e.g., driver injury severity, driver age at time of crash), raw data (variables by cases) were first input to PRELIS. This program was used to (1) assess distributional characteristics of input variables, (2) calculate appropriate correlation estimates for each pair of variables (Pearson product-moment, polychoric, or polyserial), and (3) produce correlation matrices. The PRELIS-estimated correlation matrices were then analyzed with LISREL to test the Series 1 and 2 models.

For reporting purposes, we focus mostly on direct effects revealed by these models. More complex interpretations could also focus on indirect effects, i.e., the effects of an independent variable on a dependent variable through an intervening variable.

Series 1 Models

Series 1 models listed in Tables 4a through 4e were tested on each of five subsets of Data Set 3: (1) 16 models of single vehicle crashes; (2) 16 models of multiple vehicle crashes; (3) 8 models of sport/street bike crashes; (4) 8 models of cruiser crashes; and (5) 8 models of crashes of unknown motorcycle types. Preliminary analyses revealed that these breakdowns are potentially important to understanding factors implicated in motorcycle crashes.

Series 1 Single Vehicle Crash Models. Sixteen models were tested on single vehicle crashes. As shown in Table 4a, each model included a distinct set of variables. For example, Models 1 through 4 tested the effects on crash outcomes of the contributing driver actions of *speeding* and *over/under-compensation on a curve*. Models 1 and 3 included the crash outcome of *severity of injuries* to the motorcycle drivers, and Models 2 and 4 included the crash outcome of motorcycle driver *fatalities*. (Because the fatality variable was recoded from the injury severity variable, these variables were included in separate models for statistical reasons, i.e., non-independence). Models 1 and 2 included the driving record variables of *number of sanctions*, *number of DUI violations*, and *number of speeding violations*. (Note that driving records show violations for any vehicle driven; type of vehicle, whether motorcycle or otherwise, is not recorded.) Models 3 and 4 included the demographic variables of *gender* and *MBAC*. Likewise, Models 5 through 8 included the focal contributing driver action of *improper driving*, Models 9 through 12 included the focal contributing driver action of *driver inexperience*, and Models 13 through 16 included the focal contributing driver action of *other improper driving*.

Variables included in a given model were determined by the available data and by factors that influenced the original coding of data. Crash report forms completed by investigating officers provide 4 fields for recording contributing driver actions, with 32 codes for specific actions (e.g., 08 = running stop sign, 11 = tailgating, 23 = speeding). For analysis purposes, a given contributing action such as *speeding* was coded as implicated in the crash if it was recorded in any of the four contributing action fields (and coded as not implicated if it was not recorded in any of these fields). Thus, at most 4 of the 32 available codes could be used for a given crash report, and in most crash reports fewer than 4 codes were actually used. These facts presented complications for statistical analyses. The limitation of at most 4 driver actions coded out of 32 possible actions meant, in effect, that driver actions were not statistically independent. The solution was to analyze driver actions in separate models (with the exception of *speeding* and *over-*

/under-compensation on a curve, which were often recorded jointly by officers and were therefore included in the same models).

We were provided with driving records for all drivers involved in motorcycle crashes during the study period whose records also showed an MBAC. We did not have driving records for drivers who crashed on a motorcycle whose records did not show an MBAC. Thus, we had driving records for 24,769 drivers, or 89.2% of the Data Set 3 drivers. For statistical reasons, data used to test crash models were compiled according to rules of *listwise deletion* of missing data. (Listwise deletion refers to handling of missing data. With listwise deletion, only cases with valid data for all variables in the analysis are included. The most commonly used alternative to listwise deletion is *pairwise deletion*, according to which all cases with valid data are included when variables are considered in pairs – this produces a data file with differing numbers of cases from one variable to the next.) Due to listwise deletion, the MBAC variable and driving record variables could not be included in the same models (because MBAC would be a constant in any model with driving record variables – *all* cases *with* driving record information had an MBAC, *no* cases *without* driving record information had an MBAC).

In sum, these factors – separate models for each contributing driver action, injury severity vs. fatality, and MBAC vs. driving records – in combination produced the 16 Series 1 single vehicle crash models tested, as well are the parallel 16 multiple vehicle crash models. The numbers of Series 1 models tested for the sport/street bike, cruiser, and unknown motorcycle type breakdowns were reduced from 16 to 8 by limiting these models to those including injury severity (i.e., fatalities were not studied for motorcycle type breakdowns). Thus, there are 56 Series 1 models.

Models 1 and 2: Driving Records, Speeding, Severity of Injuries, and Fatalties. The first two models tested relationships among: (a) a motorcycle driver's history regarding specific types of violations (i.e., speeding and DUI convictions); (b) the driver's age at the time of the crash; (c) whether speeding, over/under-compensating on a curve, DUI, and helmet use were factors in the crash; and (d) crash outcomes including severity of driver injuries (Model 1) and fatalities (Model 2).

Each model shows: (1) each variable's relationship to other variables by connecting arrows (or lack of relationship – no connecting arrows); (2) which variables explain a variable (i.e., speeding at the time of the crash is influenced by number of speeding and DUI violations on a driver's record, the driver's age at the time of the crash, and whether the driver was DUI at the time of the crash); (3) the direction of influences among variables (e.g., DUI at the time of the crash influences speeding, speeding does not influence DUI); (4) the strength of the relationships among variables – given by the numerical values associated with arrows (i.e., the path coefficients: the higher the absolute value of a path coefficient, the stronger the influence of one variable on the other); and (5) the sign of the relationships among variables, positive (e.g., speeding is associated with more severe injury than not speeding) or negative (e.g., older drivers are less likely to speed than younger drivers).

Table 4a. Series 1 Models for Single Vehicle Motorcycle Crashes, 1997-2007

Single Vehicle Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
1	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations Driver's Age (at time of crash)
2	Driver Fatality		
3	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
4	Driver Fatality		
5	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations Driver's Age (at time of crash)
6	Driver Fatality		
7	Driver Injury Severity	DUI Improper Driving Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
8	Driver Fatality		
9	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations Driver's Age (at time of crash)
10	Driver Fatality		
11	Driver Injury Severity	DUI Inexperience Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
12	Driver Fatality		
13	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations Driver's Age (at time of crash)
14	Driver Fatality		
15	Driver Injury Severity	DUI Other Improper Driving Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
16	Driver Fatality		

Note. Number of Crashes: 9,717 for Models 1, 2, 5, 6, 9, 10, 13, and 14; 10,885 for Models 3, 4, 7, 8, 11, 12, 15, and 16.

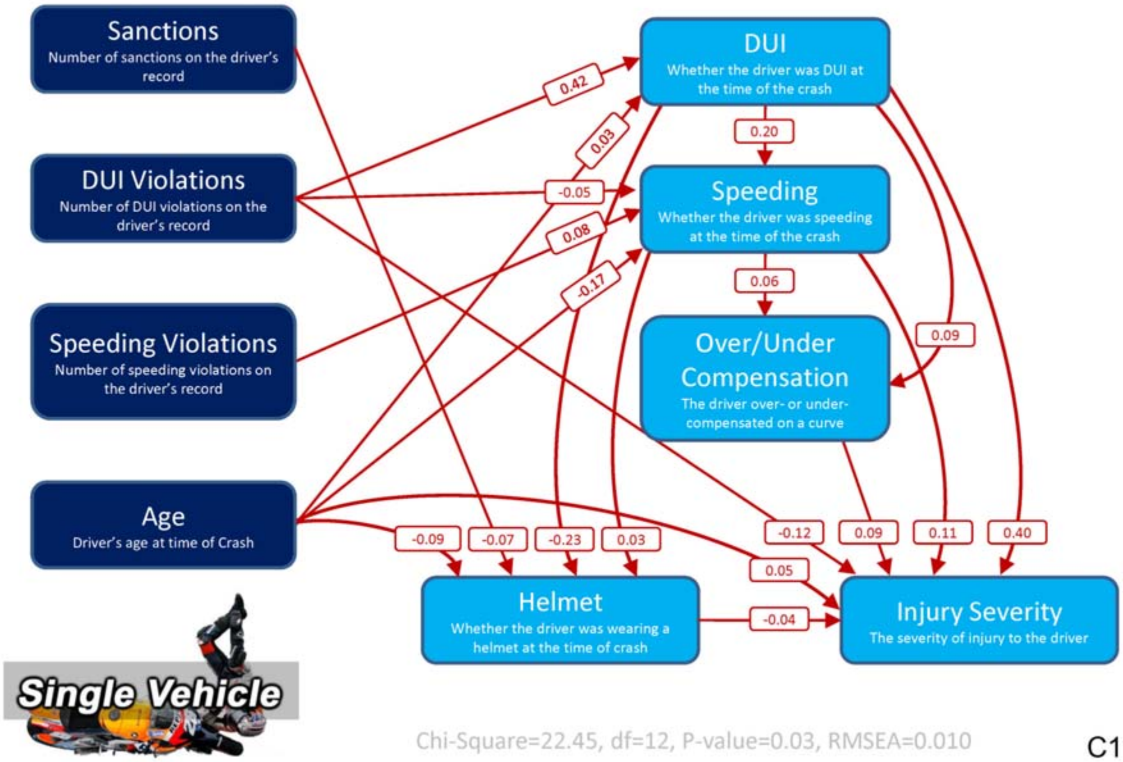
Model 1 shows results for 9,717 single vehicle crashes, with severity of driver injuries as the crash outcome, speeding, over/under-compensating, DUI, and helmet use as crash factors, and driving records and age as antecedent factors. A total of six variables in the model directly influenced injury severity. In descending order of magnitude of influence, these are: DUI at the time of the crash, number of DUI violations on record, speeding at the time of the crash, over/under-compensating on a curve, driver age, and helmet use. The path coefficient for DUI at the time of the crash (.40) reveals that it had the greatest influence of any of these variables, such that DUI drivers were likely to be more severely injured than non-DUI drivers. Drivers who were speeding (.11) were also likely to be more severely injured than non-speeding drivers. Drivers who over- or under-compensated on a curve (.09) were likely to be more severely injured than drivers who did not. Older drivers were likely to be more severely injured than younger drivers (.05), although this effect was small. Drivers wearing helmets were likely to be less severely injured than drivers not wearing helmets (-.04), although this effect was also quite small. Drivers with records of DUI violations were likely to be less severely injured than drivers without such records (-.12) – we offer an explanation for this apparently anomalous finding below.

DUI at time of crash plays a central role in Model 1 (and in all other crash models tested). In addition to greater likelihood of severe injury, DUI drivers were more likely to speed (.20) and less likely to wear a helmet (-.23) at the time of the crash. Two antecedent factors in the model influenced DUI at the time of the crash: number of DUI violations on record (.42) and driver age (.03). Drivers with DUI convictions on record were substantially more likely to crash while DUI than drivers without DUI convictions. Considering that the probability of being caught for DUI is small, it may be that drivers who crash while DUI frequently ride in this condition. Older drivers were slightly more likely to be DUI than younger drivers.

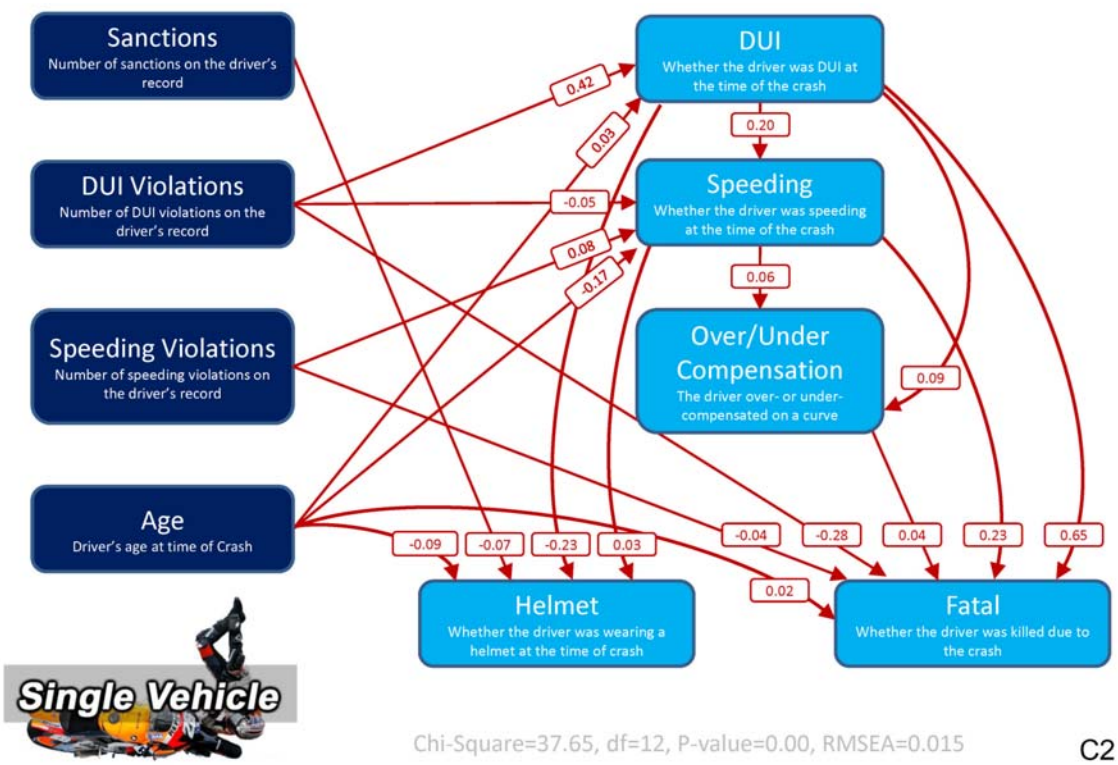
There was a small positive relationship between number of speeding violations on record and the likelihood of speeding at the time of the crash (.08), suggesting that drivers who regularly exceeded the speed limits also did so when riding. Younger drivers were more likely to speed (-.17) than older drivers, as were DUI drivers (.20). Older drivers (-.09) and DUI drivers (-.23) were less likely to wear a helmet at the time of the crash.

The negative path from number of DUI violations and crash outcome shown in Model 1 (and in all other models tested that included number of DUI violations) probably indicates a tendency for some drivers with a history of DUI violations to avoid speeding when they are drunk-riding. Models 1 and 2 include significant negative paths (-.05 in both models) from number of DUI violations to speeding at time of the crash. Although number of DUI violations on record influenced whether the driver was DUI at the time of the crash, and being DUI increased the likelihood of speeding, some DUI drivers appear to have avoided speeding to avoid being caught for DUI. When they nevertheless crashed they did so at lower speeds, thus mitigating crash outcomes. Other DUI drivers, particularly those without a history of DUI convictions, were also speeding, and the combination of DUI and speeding exacerbated crash severity.

Model 1. Driving Record, Driver Actions (Speeding, Over/Under Compensation), Severity



Model 2. Driving Record, Driver Actions (Speeding, Over/Under Compensation), Fatality



Model 2 shows results for 9,717 single vehicle crashes, with driver fatalities as the crash outcome variable. The paths in this model are similar to those shown in Model 1, with a couple of exceptions. The path from helmet use to fatalities is absent, and a path showing an inverse relationship between number of speeding violations and fatalities (-.04) is present. Another noteworthy difference between Models 1 and 2 concerns the magnitudes of the path coefficients for variables that directly influence fatalities. DUI (.65) and speeding (.23) at the time of the crash have even greater influences on driver fatalities than on severity of injuries. That is, not only are DUI and speeding drivers likely to be more severely injured, they are even more likely to be killed than non-DUI and non-speeding drivers who crash. As noted above, some drivers who have records of DUI violations avoid speeding, probably to avoid getting caught for DUI; these drivers are even less likely to be killed in a crash (-.28).

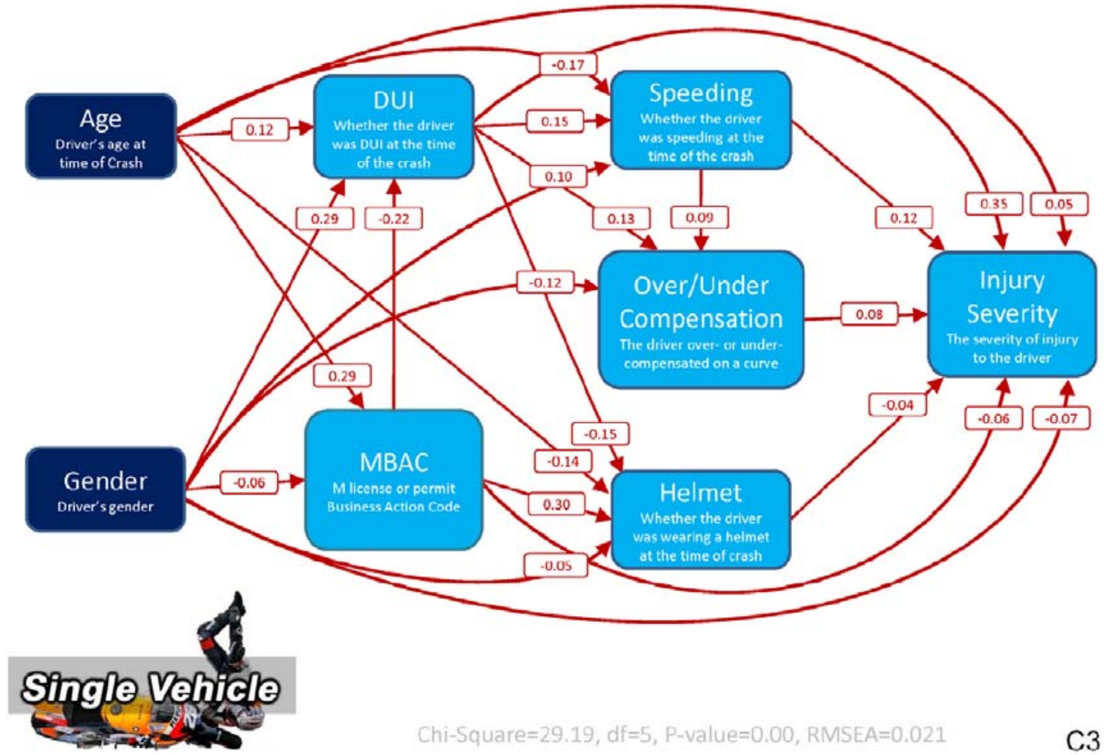
Models 3 and 4: Driver Demographics, Speeding, Severity of Injuries, and Fatalities. Models 3 and 4 tested relationships among: (a) motorcycle driver demographic variables (i.e., the driver's age at the time of the crash, driver gender, and MBAC); (b) whether speeding, over/under-compensating on a curve, DUI, and helmet use were factors in the crash; and (c) crash outcomes including severity of driver injuries (Model 3) and fatalities (Model 4). Models 3 and 4 were tested using 10,885 single vehicle crashes.

DUI at the time of the crash had the greatest influence on crash outcomes; DUI drivers were likely to be more severely injured (.35, Model 3) or killed (.50, Model 4) than non-DUI drivers. Speeding had the second greatest influence on crash outcomes; speeders were likely to be more severely injured (.12, Model 3) or killed (.21, Model 4). Drivers who over- or under-compensated on a curve were likely to be more severely injured (.08, Model 3) or killed (.05, Model 4). Male drivers were likely to suffer less severe injuries than female drivers (-.07, Model 3), but males were more likely to be killed than females (.19, Model 4). Older drivers were likely to be more severely injured (.05, Model 3) or killed (.04, Model 4) than younger drivers. Drivers with an MBAC were likely to be less severely injured (-.06, Model 3) or killed (-.02, Model 4) than drivers without an MBAC. Drivers wearing helmets were likely to be less severely injured (-.04, Model 3), but more likely to be killed (.04, Model 4), than drivers who were not wearing helmets. These apparently contradictory findings regarding the effects of helmet use can probably be explained by the speeding variable: wearing a helmet probably mitigated the adverse effects of speed on injury up to a point, beyond which helmet use lost its beneficial effects and drivers were killed by the forces encountered in the crash due to the speed traveled.

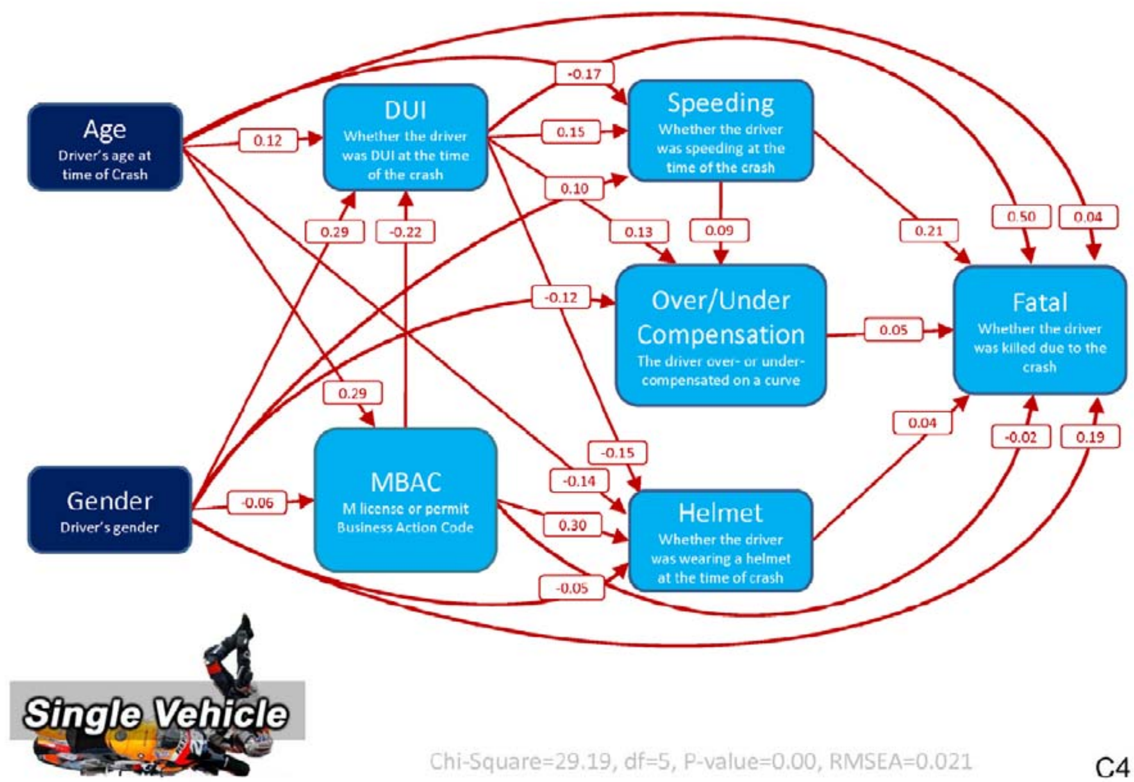
Other noteworthy findings of Model 3 and 4 analyses include: Older drivers were more likely to have an MBAC than younger drivers (.29), and males were somewhat less likely to have an MBAC than females drivers (-.06). MBAC holders were less likely to be DUI (-.22) and more likely to wear a helmet (.30) than drivers without an MBAC. In addition to being somewhat less likely to have an MBAC, male drivers were more likely to be DUI (.29) and to speed (.10), and less likely to over/under-compensate on a curve (-.12) and to wear a helmet (-.05) than female drivers.

Models 5 through 56: Single Vehicle, Multiple Vehicle, Sport Bike, Cruiser, and Unknown Bike Type Crashes. Models 5 through 56 are presented in Appendix G, including the remaining models listed in Table 4a for single vehicle crashes with contributing driver actions of *improper driving*, *driver inexperience*, and *other improper driving*, the multiple vehicle crash models listed in Table 4b, the sport/street bike crash models listed in Table 4c, the cruiser crash models listed in Table 4d, and the unknown bike type crash models listed in Table 4e. These models are not discussed in detail here because of the large number of models and path coefficients. There are substantial consistencies in findings across these models, however, as well as variations according to breakdown variables that are quite informative. We summarize these findings in the next section.

Model 3. Demographics, Driver Actions (Speeding, Over/Under Compensation), Severity



Model 4. Demographics, Driver Actions (Speeding, Over/Under Compensation), Fatality



Findings of Series 1 Models

The findings of the Series 1 models for motorcycle crashes that occurred between 1997 and 2007 are summarized in Tables 6 through 15. These tables show the factors that influenced crash outcomes (severity of driver injuries and fatalities) and driver actions (DUI, speeding, helmet use, driver inexperience, over/under-compensation on a curve, improper driving, other improper driving, and MBAC).

The tables are designed to facilitate comparisons across breakdown variables (single and multiple vehicle crashes, sport/street bike, cruiser, and unknown bike type crashes) and across contributing factors (driver actions, driver choices, driving record, and driver demographics). Each cell presents the average path coefficient, the number of statistically significant paths relative to the number of models in which the path was tested, and the range of path coefficients across models in which the path was tested.

Table 5: Contributors to Severity of Driver Injuries. The first row of Table 5 shows the effects of DUI on severity of driver injuries for single and multiple vehicle crashes, and for sport bike, cruiser, and unknown bike type crashes. All values are positive, indicating that drivers who were DUI at the time of the crash were likely to sustain more severe injuries than drivers who were not DUI. The average path coefficient is greater for multiple vehicle crashes (.54) than for single vehicle crashes (.40), indicating that DUI played a somewhat greater role in determining injury severity in the former vs. the latter crashes. Comparing types of motorcycles, DUI played a somewhat greater role in determining injury severity in cruiser crashes (.48) as compared to sport bike (.41) and unknown bike type (.39) crashes.

It should be noted that the single and multiple vehicle crash samples are distinct from one another (i.e., they have no cases in common), and that sport bike, cruiser, and unknown bike type samples are also mutually exclusive. However, single and multiple crash samples are not independent of the sport bike, cruiser, and unknown bike type samples – single and multiple crashes include all three types of motorcycles. With sample characteristics in mind, it is noteworthy that each of the DUI – injury severity coefficients is the largest value in its respective column. DUI has a greater impact on injury severity than any other contributing factor, regardless of type of crash or type of motorcycle. The fact that the path coefficients shown are standardized allows us to directly compare them to determine relative effect sizes.

Other findings shown in Table 5 are also noteworthy. Speeding influenced injury severity, such that speeding drivers were more severely injured than drivers who were not speeding. The effect was the same regardless of whether it was a single or multiple vehicle crash (.12). Speeding had the greatest influence on injury severity for sport bike crashes (.14), and the least for cruiser crashes (.06). Compared to DUI, speeding played a

Table 4b. Series 1 Models for Multiple Vehicle Motorcycle Crashes, 1997-2007

<table>
<tr><th colspan="4">Multiple Vehicle Crashes</th></tr>
<tr><th>Model</th><th>Crash Outcomes</th><th>Crash Factors</th><th>Antecedent Factors</th></tr>
<tr><td>17</td><td>Driver Injury Severity</td><td rowspan="2">Speeding
Over/Under Compensation
DUI
Helmet Use</td><td rowspan="2">Number of Sanctions
Number of Speeding Violations
Number of DUI Violations
Driver's Age (at time of crash)</td></tr>
<tr><td>18</td><td>Driver Fatality</td></tr>
<tr><td>19</td><td>Driver Injury Severity</td><td rowspan="2">Speeding
Over/Under Compensation
DUI
Helmet Use
MBAC</td><td rowspan="2">Driver's Age (at time of crash)
Driver's Gender</td></tr>
<tr><td>20</td><td>Driver Fatality</td></tr>
<tr><td>21</td><td>Driver Injury Severity</td><td rowspan="2">DUI
Improper Driving
Helmet Use</td><td rowspan="2">Number of Sanctions
Number of DUI Violations
Number of Improper Driving Violations
Driver's Age (at time of crash)</td></tr>
<tr><td>22</td><td>Driver Fatality</td></tr>
<tr><td>23</td><td>Driver Injury Severity</td><td rowspan="2">DUI
Improper Driving
Helmet Use
MBAC</td><td rowspan="2">Driver's Age (at time of crash)
Driver's Gender</td></tr>
<tr><td>24</td><td>Driver Fatality</td></tr>
<tr><td>25</td><td>Driver Injury Severity</td><td rowspan="2">DUI
Inexperience
Helmet Use</td><td rowspan="2">Number of Sanctions
Number of DUI Violations
Driver's Age (at time of crash)</td></tr>
<tr><td>26</td><td>Driver Fatality</td></tr>
<tr><td>27</td><td>Driver Injury Severity</td><td rowspan="2">DUI
Inexperience
Helmet Use
MBAC</td><td rowspan="2">Driver's Age (at time of crash)
Driver's Gender</td></tr>
<tr><td>28</td><td>Driver Fatality</td></tr>
<tr><td>29</td><td>Driver Injury Severity</td><td rowspan="2">DUI
Other Improper Driving
Helmet Use</td><td rowspan="2">Number of Sanctions
Number of DUI Violations
Number of Improper Driving Violations
Driver's Age (at time of crash)</td></tr>
<tr><td>30</td><td>Driver Fatality</td></tr>
<tr><td>31</td><td>Driver Injury Severity</td><td rowspan="2">DUI
Other Improper Driving
Helmet Use
MBAC</td><td rowspan="2">Driver's Age (at time of crash)
Driver's Gender</td></tr>
<tr><td>32</td><td>Driver Fatality</td></tr>
</table>

Note. Number of Crashes: 10,718 for Models 17, 18, 21, 22, 25, 26, 29, and 30; 11,850 for Models 19, 20, 23, 24, 27, 28, 31, and 32.

Table 4c. Series 1 Models for Sport Bike Motorcycle Crashes, 1997-2007

Sport Bike Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
33	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations Driver's Age (at time of crash)
34	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
35	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations Driver's Age (at time of crash)
36	Driver Injury Severity	DUI Improper Driving Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
37	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations Driver's Age (at time of crash)
38	Driver Injury Severity	DUI Inexperience Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
39	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations Driver's Age (at time of crash)
40	Driver Injury Severity	DUI Other Improper Driving Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender

Note. Number of Crashes: 3,649 for Models 33, 35, 37, and 39; 4,096 for Models 34, 36, 38, and 40.

Table 4d. Series 1 Models for Cruiser Motorcycle Crashes, 1997-2007

Cruiser Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
41	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations Driver's Age (at time of crash)
42	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
43	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations Driver's Age (at time of crash)
44	Driver Injury Severity	DUI Improper Driving Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
45	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations Driver's Age (at time of crash)
46	Driver Injury Severity	DUI Inexperience Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
47	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations Driver's Age (at time of crash)
48	Driver Injury Severity	DUI Other Improper Driving Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender

Note. Number of Crashes: 10,298 for Models 41, 43, 45, and 47; 10,919 for Models 42, 44, 46, and 48.

Table 4e. Series 1 Models for Unknown Bike Type Motorcycle Crashes, 1997-2007

Unknown Bike Type Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
49	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations Driver's Age (at time of crash)
50	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
51	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations Driver's Age (at time of crash)
52	Driver Injury Severity	DUI Improper Driving Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
53	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations Driver's Age (at time of crash)
54	Driver Injury Severity	DUI Inexperience Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender
55	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations Driver's Age (at time of crash)
56	Driver Injury Severity	DUI Other Improper Driving Helmet Use MBAC	Driver's Age (at time of crash) Driver's Gender

Note. Number of Crashes: 5,960 for Models 49, 51, 53, and 55; 6,988 for Models 50, 52, 54, and 56.

Table 5. Contributors to Severity of Injuries, Series 1 Models 1997-2007

		(5/8, .03 to .05)	(1/8, .04 to .04)	Type of Crash	(8/8, .07 to .08)	(4/8, .03 to .04)
	Driver Gender	-.06 (4/4, -.07 to -.03)	-.08 (4/4, -.09 to -.07)	-.05 (1/4, -.05 to -.05)	-.09 (4/4, -.1 to -.08)	-.04 (3/4, -.05 to -.04)
Driver Actions	DUI	(8/8, .35 to .45)	(8/8, .49 to .58)	(8/8, .34 to .47)	(8/8, .46 to .49)	(8/8, .32 to .45)
Driver Actions	Speeding	.12 (2/2, .11 to .12)	.12 (2/2, .09 to .14)	.14 (2/2, .12 to .16)	.06 (2/2, .06 to .06)	.11 (2/2, .09 to .13)
Driver Actions	Under/Over Compensation	.09 (2/2, .08 to .09)	-	.07 (1/2, .07 to .07)	.02 (1/2, .02 to .02)	.08 (2/2, .06 to .1)
Driver Actions	Improper Driving	-	-.08 (2/2, -.09 to -.06)	-	-	-
Driver Actions	Inexperience	.10 (2/2, .09 to .11)	.05 (1/2, .05 to .05)	.09 (2/2, .08 to .1)	.08 (2/2, .05 to .1)	.05 (2/2, .05 to .05)
Driver Actions	Other Improper Driving	-	-.13 (2/2, -.13 to -.12)	-	-.04 (2/2, -.04 to -.04)	-.08 (2/2, -.09 to -.06)
Driver Choices	Helmet	-.04 (8/8, -.05 to -.03)	.07 (8/8, .05 to .08)	-	-	.03 (2/8, .03 to .03)
Driver Choices	MBAC	-.06 (3/4, -.06 to -.06)	-.07 (3/4, -.08 to -.06)	-.11 (4/4, -.11 to -.09)	-.03 (2/4, -.03 to -.02)	-.06 (4/4, -.06 to -.05)
Driving Record	Number of Sanctions	-	-	-	.02 (2/4, .02 to .02)	-
Driving Record	Number of DUIs	-.13 (4/4, -.13 to -.12)	-.15 (4/4, -.15 to -.14)	-.15 (4/4, -.15 to -.15)	-.13 (4/4, -.13 to -.12)	-.15 (4/4, -.15 to -.14)
Driving Record	Number of Speeding	-	-	-	-	-
Driving Record	Number of Improper Driving	-	-	-	-	-
mo gr	Driver Age	.05	.04	-	.08	.04

Note. Blank cells indicate non-significant contributors/model paths.

lesser role in determining injury severity. Over- or under-compensation on a curve also contributed to injury severity for all except multiple vehicle crashes.

Inexperienced drivers tended to suffer somewhat more severe injuries than experienced drivers, especially for single (.10) as compared to multiple vehicle crashes (.05). Driver actions of improper driving (-.08) and other improper driving (-.13) were negatively related to injury severity for multiple vehicle crashes, but not single vehicle crashes. Investigating officers tended to attribute crashes to these driver actions when injuries were less severe.

Helmet use showed a small negative relationship to injury severity for single vehicle crashes (-.04), but a positive relationship for multiple vehicle crashes (.07). Wearing a helmet tended to mitigate injury severity for the former, but exacerbate it for the latter crashes. No relationship was found between helmet use and injury severity for sport bike and cruiser crashes, perhaps because these crashes were not analyzed separately for single and multiple vehicle crashes and the respective effects of helmets cancelled out.

MBAC showed consistently small negative relationships with injury severity. Drivers with an MBAC sustained somewhat less severe injuries than drivers who did not (-.06 for single vehicle crashes, -.07 for multiple vehicle crashes). This effect was strongest for sport bike drivers (-.11), and weakest for cruiser drivers (-.03).

Number of DUI convictions on a driver's record displayed moderately negative relationships to injury severity, with path coefficients ranging from -.13 to -.15. Drivers with DUI convictions tended to be less severely injured. As noted earlier, these drivers also tended to be DUI in their crashes, and may have been driving more slowly to avoid being stopped for speeding and thus incur another DUI (and associated penalties). Their injuries were mitigated because they crashed at lower speeds than drivers who were DUI and speeding. It is noteworthy that this effect appeared for all types of crashes.
Driver age showed small positive relationships to injury severity for all types of crashes except sport bikes. Older drivers tended to be more severely injured than younger drivers. Driver gender showed consistently small negative relationships to injury severity for all types of crashes. Males were somewhat less severely injured than females.

Table 6: Contributors to Driver Fatalities. Table 6 shows the effects of contributing factors on driver fatalities for single and multiple vehicle crashes. (Driver fatality models were not tested for sport bike, cruiser, and unknown bike type crashes.) Several findings regarding driver fatalities as distinct from injury severities are noteworthy. First, the strongest effects in Table 5 are even stronger in Table 6. DUI plays a greater role in crash fatalities than injuries for both single (.62 vs. .40) and multiple (.68 vs. .54) vehicle crashes. Speeding also plays a greater role in fatalities than injuries (single vehicle, .22 vs. .12; multiple vehicle, .21 vs. .12). Helmet use slightly increases the likelihood of fatalities for both single (.03) and multiple (.08) vehicle crashes. Males were substantially more likely than females to die in single vehicle crashes (.22), but somewhat less likely to die in multiple vehicle crashes (-.08).

Table 6. Contributors to Driver Fatalities, Series 1 Models 1997-2007

	Factor	Vehicle	Vehicle	Sport Bike	Cruisers	Type
	Driver Gender	.22 (4/4, .19 to .28)	-.08 (4/4, -.09 to -.05)			
Driver Actions	DUI	.62 (8/8, .5 to .74)	.68 (8/8, .6 to .76)			
	Speeding	.22 (2/2, .21 to .23)	.21 (2/2, .17 to .24)			
	Under/Over Compensation	.05 (2/2, .04 to .05)	.09 (2/2, .05 to .12)			
	Improper Driving	.05 (2/2, .05 to .05)	-.04 (2/2, -.06 to -.02)			
	Inexperience	.17 (2/2, .12 to .22)	.13 (2/2, .12 to .13)			
	Other Improper Driving	-	-.17 (2/2, -.17 to -.16)			
Driver Choices	Helmet	.03 (7/8, .02 to .05)	.08 (8/8, .06 to .1)			
	MBAC	-.02 (2/4, -.02 to -.02)	-.09 (4/4, -.12 to -.06)			
Driving Record	Number of Sanctions	.04 (1/4, .04 to .04)	-			
	Number of DUIs	-.29 (4/4, -.3 to -.28)	-.20 (4/4, -.2 to -.19)			
	Number of Speeding	-.04 (1/1, -.04 to -.04)	-			
	Number of Improper Driving	-.05 (2/2, -.05 to -.04)	-.04 (2/2, -.04 to -.03)			
Driver Demographics	Driver Age	.03 (4/8, -.02 to .06)	.00 (4/8, -.04 to .04)			

Note. Driver fatality models were not tested for sport bike, cruiser, and unknown bike type crashes; therefore, these columns are blank. Blank cells indicate non-significant contributors/model paths.

Table 7. Contributors to DUI at Time of Crash, Series 1 Models 1997-2007

	Contributing Factor	Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
		(4/4, .24 to .29)	(4/4, .25 to .25)	(4/4, .04 to .07)	(4/4, .28 to .3)	(4/4, .14 to .17)
Driver Actions	DUI	-	-	-	-	-
	Speeding	-	-	-	-	-
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-	-	-	-	-
	Inexperience	-.17 (2/2, -.19 to -.14)	.06 (1/2, .06 to .06)	-.07 (1/2, -.07 to -.07)	-.02 (2/2, -.06 to .03)	-.08 (2/2, -.08 to -.07)
	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
	MBAC	-.23 (4/4, -.24 to -.22)	-.23 (4/4, -.23 to -.23)	-.26 (4/4, -.27 to -.26)	-.22 (4/4, -.22 to -.22)	-.28 (4/4, -.29 to -.28)
Driving Record	Number of Sanctions	-	-	.05 (4/4, .05 to .05)	-	.04 (1/4, .04 to .04)
	Number of DUIs	.42 (4/4, .4 to .42)	.34 (4/4, .34 to .34)	.38 (4/4, .38 to .38)	.36 (4/4, .36 to .36)	.44 (4/4, .43 to .45)
	Number of Speeding	-	-	-	-	-
	Number of Improper Driving	-	-	-	-	.07 (2/2, .07 to .07)
Driver Demographics	Driver Age	.08 (7/8, .03 to .12)	.07 (8/8, .02 to .12)	.12 (8/8, .11 to .14)	-.06 (8/8, -.08 to -.04)	.11 (4/8, .09 to .11)
	Driver Gender	.28	.25	.06	.29	.16

Note. Blank cells indicate non-significant contributors/model paths.

Table 7: Contributors to DUI at Time of Crash. DUI plays an important role in crash outcomes. Table 7 summarizes factors that affect whether or not a driver is DUI at the time of the crash. The strongest influence on DUI at crash is the number of DUI convictions on a driver's record. The effect is somewhat greater for single vs. multiple vehicle crashes (.42 vs. .34). For some drivers, DUI is a consistent behavior that contributes to the severity of crash outcomes. As shown by analyses of Data Set 1 presented in Table 2 (Analysis 2), a history of DUI convictions may also increase the likelihood of a crash.

Male drivers were more likely to be DUI at crash than female drivers for both single (.28) and multiple (.25) vehicle crashes. The tendency for males to be DUI as compared to females was greatest for cruiser crashes (.29), and weakest for sport bike crashes (.06). MBAC drivers were less likely to be DUI at crash than non-MBAC drivers, regardless of type of crash (values range from -.28 for unknown bike type crashes to -.22 for cruiser crashes). Older drivers were somewhat more likely to be DUI at crash than younger drivers for sport bike (.12) and unknown bike type (.11) crashes, but somewhat less likely for cruiser crashes (-.06). Drivers who were described by investigating officers as inexperienced were less likely to be DUI in single vehicle crashes (-.17), but somewhat more likely to be DUI in multiple vehicle crashes (.06).

Table 8: Contributors to Speeding at Time of Crash. Several factors increased the likelihood of speeding at the time of the crash. Chief among these was DUI, especially in multiple vehicle crashes (.30). DUI drivers were more likely to be speeding, regardless of type of motorcycle (sport bikes = .32; cruisers = .35; unknown bike type = .27). Second in importance was driver age – younger drivers were more likely to be speeding in single (-.17) and multiple (-.22) vehicle crashes. Driver gender also played a role, with males more likely to speed than females in single (.10) and multiple (.09) vehicle crashes. Considering type of motorcycle, however, a more complex pattern was found. Males were more likely than females to speed in sport bike (.17) and unknown bike type (.11) crashes, but females were more likely than males to speed in cruiser crashes (-.09). A driver's record of speeding convictions also increased the likelihood of speeding (.08), suggesting that speeding, like DUI, is a reliable behavior that probably occurs on a regular basis for some drivers. Finally, drivers with DUI convictions were somewhat less likely to speed (values range from -.05 for single vehicle crashes to -.09 for multiple vehicle crashes). As noted previously, these results suggest that some drivers with past DUI convictions are less likely to speed, probably as a strategy to avoid being stopped and charged with DUI.

Table 9: Contributors to Helmet Use at Time of Crash. Several factors increased the likelihood of wearing a helmet at the time of the crash. Chief among these was MBAC. MBAC drivers were more likely to wear a helmet than drivers without an MBAC, especially sport bike (.32) and unknown bike type (.44) drivers. DUI drivers were less likely to wear a helmet than non-DUI drivers, especially in single vehicle crashes (-.19). Older drivers were somewhat less likely to wear a helmet than younger drivers,

Table 8. Contributors to Speeding at Time of Crash, Series 1 Models 1997-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	.18 (2/2, .15 to .2)	.30 (2/2, .26 to .33)	.32 (2/2, .28 to .36)	.35 (2/2, .34 to .35)	.27 (2/2, .23 to .3)
Driver Actions	Speeding	-	-	-	-	-
Driver Actions	Under/Over Compensation	-	-	-	-	-
Driver Actions	Improper Driving	-	-	-	-	-
Driver Actions	Inexperience	-	-	-	-	-
Driver Actions	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
Driver Choices	MBAC	-	-	-	-	-
Driving Record	Number of Sanctions	-	-	-	-	-
Driving Record	Number of DUIs	-.05 (1/1, -.05 to -.05)	-.09 (1/1, -.09 to -.09)	-.09 (1/1, -.09 to -.09)	-.06 (1/1, -.06 to -.06)	-.07 (1/1, -.07 to -.07)
Driving Record	Number of Speeding	.08 (1/1, .08 to .08)	.08 (1/1, .08 to .08)	.09 (1/1, .09 to .09)	.08 (1/1, .08 to .08)	.08 (1/1, .08 to .08)
Driving Record	Number of Improper Driving	-	-	-	-	-
Driver Demographics	Driver Age	-.17 (2/2, -.17 to -.17)	-.22 (2/2, -.22 to -.22)	-.14 (2/2, -.16 to -.12)	-	-.22 (2/2, -.22 to -.21)
Driver Demographics	Driver Gender	.10 (1/1, .1 to .1)	.09 (1/1, .09 to .09)	.17 (1/1, .17 to .17)	-.09 (1/1, -.09 to -.09)	.11 (1/1, .11 to .11)

Note. Blank cells indicate non-significant contributors/model paths.

Table 9. Contributors to Helmet Use at Time of Crash, Series 1 Models 1997-2007

		(8/8, -.14 to -.09)	(8/8, -.14 to -.05)	(8/8, -.09 to -.08)	(8/8, -.08 to -.07)	(4/8, -.1 to -.08)
				Type of Crash		
	Driver Gender	-.05 (4/4, -.05 to -.05)	-	-	-.04 (4/4, -.05 to -.04)	-.04 (3/4, -.04 to -.04)
Driver Actions	DUI	(8/8, -.23 to -.15)	(8/8, -.19 to -.06)		(8/8, -.2 to -.14)	(8/8, -.25 to -.06)
	Speeding	.03 (1/2, .03 to .03)	-	.06 (1/2, .06 to .06)	-.04 (1/2, -.04 to -.04)	.11 (2/2, .09 to .12)
	Under/Over Compensation	-	.13 (2/2, .12 to .13)	.07 (2/2, .06 to .07)	.03 (1/2, .03 to .03)	.10 (2/2, .08 to .11)
	Improper Driving	-.03 (1/2, -.03 to -.03)	.06 (2/2, .04 to .07)	-	.04 (1/2, .04 to .04)	-.03 (1/2, -.03 to -.03)
	Inexperience	-	.06 (2/2, .05 to .07)	.04 (1/2, .04 to .04)	-.03 (1/2, -.03 to -.03)	.08 (2/2, .08 to .08)
	Other Improper Driving	-.05 (1/2, -.05 to -.05)	-.05 (1/2, -.05 to -.05)	-.06 (2/2, -.06 to -.05)	-.02 (1/2, -.02 to -.02)	-.04 (1/2, -.04 to -.04)
Driver Choices	Helmet	-	-	-	-	-
	MBAC	.30 (4/4, .3 to .3)	.37 (4/4, .36 to .38)	.32 (4/4, .31 to .33)	.12 (4/4, .12 to .13)	.44 (4/4, .43 to .45)
Driving Record	Number of Sanctions	-.07 (4/4, -.07 to -.07)	-.07 (4/4, -.07 to -.07)	-.09 (4/4, -.11 to -.08)	-.06 (4/4, -.06 to -.06)	-.10 (4/4, -.11 to -.1)
	Number of DUIs	-	-	-	-	.06 (4/4, .06 to .06)
	Number of Speeding	-	-	.07 (1/1, .07 to .07)	-	.06 (1/1, .06 to .06)
	Number of Improper Driving	-	-	-	-	-
mo gr	Driver Age	-.12	-.10	-.08	-.08	-.09

Note. Blank cells indicate non-significant contributors/model paths.

regardless of type of motorcycle or crash (values ranged from -.08 for sport bikes and cruisers, to -.12 for single vehicle crashes). Drivers with a history of PennDOT sanctions were less likely to wear a helmet (values ranged from -.06 to -.10), and males were slightly less likely than females to wear a helmet in single vehicle crashes (-.05). Other driver actions (speeding, over/under-compensation on a curve, improper driving, driver inexperience, and other improper driving) generally showed small and inconsistent influences on helmet use.

Table 10: Contributors to Driver Inexperience. Female drivers were substantially more likely than male drivers to be rated as inexperienced by investigating officers, especially in single (-.38) vs. multiple (-.21) vehicle crashes. Younger drivers were more likely than older drivers to be rated as inexperienced, especially in multiple (-.33) vs. single (-.21) vehicle crashes. Drivers with an MBAC were less likely to be rated as inexperienced, especially among sport bike drivers (-.24). Drivers with a records of DUI convictions were also less likely to be rated as inexperienced (values ranged from -.04 for multiple vehicle crashes to -.10 for single vehicle crashes).

Table 11: Contributors to Over/Under-compensation at a Curve. Drivers who were speeding were more likely to over- or under-compensate on a curve, especially in multiple (.30) vs. single (.08) vehicle crashes. DUI drivers were also more likely to over- or under-compensate, particularly in cruiser crashes (.26). Male drivers were less likely than females to over- or under-compensate, regardless of type of crash or motorcycle (values ranged from -.12 for single vehicle crashes to -.25 for cruiser crashes). Drivers with an MBAC were somewhat less likely to over- or under-compensate at a curve.

Table 12: Contributors to Improper Driving at Time of Crash. The most consistent influence on improper driving at the time of the crash was MBAC – MBAC drivers were less likely to drive improperly than drivers without an MBAC (values ranged from -.11 for single vehicle crashes to -.19 for multiple vehicle crashes). DUI drivers were more likely to drive improperly, especially in multiple vehicle crashes (.21). Males were somewhat less likely to drive improperly than females, and drivers with records of improper driving violations were somewhat more likely to drive improperly.

Table 13: Contributors to Other Improper Driving at Time of Crash. The most consistent influence on other improper driving was MBAC – MBAC drivers were less likely to be noted as other improper driving than drivers without an MBAC (values ranged from -.06 for sport bike crashes to -.16 for multiple vehicle crashes). Number of improper driving violations on record slightly increased the likelihood of other improper driving. The effects of other contributing factors were inconsistent in both direction and magnitude of effects across types of crashes.

Table 14: Contributors to Possession of an MBAC. Two factors affected whether or not a driver in a crash had an MBAC, driver age and gender. Older drivers were more likely than younger drivers to have an MBAC, especially drivers of cruisers (.29) and unknown bike types (.29). Males were somewhat less likely than females to have an MBAC, especially among sport bike drivers (-.22).

Table 10. Contributors to Inexperience at Time of Crash, Series 1 Models 1997-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	-	-	-	-	-
Driver Actions	Speeding	-	-	-	-	-
Driver Actions	Under/Over Compensation	-	-	-	-	-
Driver Actions	Improper Driving	-	-	-	-	-
Driver Actions	Inexperience	-	-	-	-	-
Driver Actions	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
Driver Choices	MBAC	-.12 (1/1, -.12 to -.12)	-.18 (1/1, -.18 to -.18)	-.24 (1/1, -.24 to -.24)	-.17 (1/1, -.17 to -.17)	-.09 (1/1, -.09 to -.09)
Driving Record	Number of Sanctions	-	-	-	-	-
Driving Record	Number of DUIs	-.10 (1/1, -.1 to -.1)	-.04 (1/1, -.04 to -.04)	-.06 (1/1, -.06 to -.06)	-.06 (1/1, -.06 to -.06)	-.05 (1/1, -.05 to -.05)
Driving Record	Number of Speeding	-	-	-	-	-
Driving Record	Number of Improper Driving	-	-	-	-	-
Driver Demographics	Driver Age	-.21 (2/2, -.22 to -.2)	-.33 (2/2, -.35 to -.3)	-.21 (2/2, -.22 to -.19)	-.08 (2/2, -.11 to -.05)	-.25 (2/2, -.26 to -.23)
Driver Demographics	Driver Gender	-.38 (1/1, -.38 to -.38)	-.21 (1/1, -.21 to -.21)	-.35 (1/1, -.35 to -.35)	-.41 (1/1, -.41 to -.41)	-.34 (1/1, -.34 to -.34)

Note. Blank cells indicate non-significant contributors/model paths.

Table 11. Contributors to Over/Under Compensation at Time of Crash, Series 1 Models 1997-2007

		(1/1, -.12 to -.12)	(1/1, -.18 to -.18)	(1/1, -.2 to -.2)	(1/1, -.25 to -.25)	(1/1, -.13 to -.13)
	Contributing Factor	**Single Vehicle**	**Multiple Vehicle**	**Sport Bike**	**Cruisers**	**Unknown Bike Type**
Driver Actions	DUI	.11 (2/2, .09 to .13)	.18 (2/2, .17 to .19)	-	.26 (2/2, .23 to .28)	.15 (1/2, .15 to .15)
	Speeding	.08 (2/2, .06 to .09)	.30 (2/2, .29 to .3)	.25 (2/2, .23 to .26)	.16 (2/2, .15 to .16)	.24 (2/2, .23 to .24)
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-	-	-	-	-
	Inexperience	-	-	-	-	-
	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
	MBAC	-	-.08 (1/1, -.08 to -.08)	-.10 (1/1, -.1 to -.1)	-.09 (1/1, -.09 to -.09)	-.03 (1/1, -.03 to -.03)
Driving Record	Number of Sanctions	-	-	-	-	-.07 (1/1, -.07 to -.07)
	Number of DUIs	-	-	-	-.03 (1/1, -.03 to -.03)	.07 (1/1, .07 to .07)
	Number of Speeding	-	-.09 (1/1, -.09 to -.09)	-	-	-
	Number of Improper Driving	-	-	-	-	-
Driver Demographics	Driver Age	-	-	.07 (1/2, .07 to .07)	.04 (1/2, .04 to .04)	.07 (2/2, .06 to .08)
	Driver Gender	-.12	-.18	-.20	-.25	-.13

Note. Blank cells indicate non-significant contributors/model paths.

Table 12. Contributors to Improper Driving at Time of Crash, Series 1 Models 1997-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	.04 (2/2, .03 to .05)	.21 (2/2, .2 to .22)	.06 (1/2, .06 to .06)	.08 (2/2, .07 to .08)	.07 (2/2, .05 to .08)
	Speeding	-	-	-	-	-
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-	-	-	-	-
	Inexperience	-	-	-	-	-
	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
	MBAC	-.11 (1/1, -.11 to -.11)	-.19 (1/1, -.19 to -.19)	-.13 (1/1, -.13 to -.13)	-.13 (1/1, -.13 to -.13)	-.18 (1/1, -.18 to -.18)
Driving Record	Number of Sanctions	-	-	-	-	-
	Number of DUIs	-	-	-.05 (1/1, -.05 to -.05)	-	-
	Number of Speeding	-	-	-	-	-
	Number of Improper Driving	-	.06 (1/1, .06 to .06)	.05 (1/1, .05 to .05)	.05 (1/1, .05 to .05)	.05 (1/1, .05 to .05)
Driver Demographics	Driver Age	-	-.04 (1/2, -.04 to -.04)	-.04 (1/2, -.04 to -.04)	-	-
	Driver Gender	-.04 (1/1, -.04 to -	-.11 (1/1, -.11 to -	-	-.05 (1/1, -.05 to -	-.07 (1/1, -.07 to -

		.04)	.11)		.05)	.07)

Note. Blank cells indicate non-significant contributors/model paths.

Table 13. Contributors to Other Improper Driving at Time of Crash, Series 1 Models 1997-2007

	Contributing Factor	Type of Crash: Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	-.05 (2/2, -.06 to -.03)	.20 (2/2, .16 to .24)	-.13 (2/2, -.14 to -.12)	.10 (2/2, .09 to .1)	.21 (2/2, .15 to .27)
	Speeding	-	-	-	-	-
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-	-	-	-	-
	Inexperience	-	-	-	-	-
	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
	MBAC	-.11 (1/1, -.11 to -.11)	-.16 (1/1, -.16 to -.16)	-.06 (1/1, -.06 to -.06)	-.07 (1/1, -.07 to -.07)	-.14 (1/1, -.14 to -.14)
Driving Record	Number of Sanctions	-	-	-	-	-
	Number of DUIs	-	-.05 (1/1, -.05 to -.05)	.07 (1/1, .07 to .07)	-	-.10 (1/1, -.1 to -.1)
	Number of Speeding	-	-	-	-	-
	Number of Improper Driving	.04 (1/1, .04 to .04)	.05 (1/1, .05 to .05)	.05 (1/1, .05 to .05)	-	.07 (1/1, .07 to .07)
Driver Demographics	Driver Age	-	-.06 (2/2, -.06 to -.05)	-	.04 (2/2, .03 to .04)	-.04 (2/2, -.04 to -.03)
	Driver Gender	.04 (1/1, .04 to	-.03 (1/1, -.03 to -	.09 (1/1, .09 to	-.07 (1/1, -.07 to -	-

		.04)	.03)	.09)	.07)	

Note. Blank cells indicate non-significant contributors/model paths.

Table 14. Contributors to MBAC, Series 1 Models 1997-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	-	-	-	-	-
	Speeding	-	-	-	-	-
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-	-	-	-	-
	Inexperience	-	-	-	-	-
	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
	MBAC	-	-	-	-	-
Driving Record	Number of Sanctions	-	-	-	-	-
	Number of DUIs	-	-	-	-	-
	Number of Speeding	-	-	-	-	-
	Number of Improper Driving	-	-	-	-	-
Driver Demographics	Driver Age	.29 (4/4, .29 to .29)	.34 (4/4, .34 to .34)	.06 (4/4, .06 to .06)	.29 (4/4, .29 to .29)	.29 (4/4, .29 to .29)
	Driver Gender	-.06 (4/4, -.06 to -.06)	-	-.22 (4/4, -.22 to -.22)	-.05 (4/4, -.05 to -.05)	-.10 (4/4, -.1 to -.1)

Note. Blank cells indicate non-significant contributors/model paths.

Summary of Findings of Series 1 Models

Figures 7 and 8 summarize the findings of the Series 1 models. Figure 7 shows the variables that affect each factor (driver choices, driver actions, and crash outcomes).

- Bold upward arrows indicate stronger direct effects of one variable on the other. For example, a greater number of DUI convictions substantially *increased* the likelihood that a driver was DUI at the time of the crash.
- Non-bold upward arrows indicate weaker direct effects. For example, females were somewhat *more* likely than males to have an MBAC.
- Bold downward arrows indicate stronger inverse effects. For example, drivers with an MBAC were substantially *less* likely to be DUI at the time of the crash than drivers without an MBAC.
- Non-bold downward arrows indicate weaker inverse effects. For example, drivers with an MBAC were somewhat *less* likely to be killed in a crash than drivers without an MBAC.

Bold arrows correspond to average path coefficients associated with a factor of .15 or greater, non-bold arrows correspond to average path coefficients associated with a factor of less than .15. Figure 8 summarizes the same findings as Figure 7, but organizes them according to the variables that each factor affects.

Figure 7. Findings of Series 1 Models: Effects on Driver Choices, Driver Actions, and Crash Outcomes

Driver Demographics & Records

Age

Gender

Number of DUIs

Number of Speeding Violations

Number of Improper Driving Violations

Number of Sanctions

Driver Choices

MBAC
Affected by:
- **↑** Age (Older)
- ↑ Gender (Female)

DUI
Affected by:
- **↑** Number of DUIs
- **↑** Gender (Male)
- **↓** MBAC
- ↑ Age (Older)
- ↓ Inexperience

Helmet Use
Affected by:
- **↑** MBAC
- **↓** DUI
- ↓ Age (Older)
- ↓ Number of Sanctions
- ↓ Other Improper Driving

Driver Actions

Speeding
Affected by:
- **↑** DUI
- **↑** Age (Younger)
- ↑ Gender (Male)
- ↑ Number of Speeding Violations
- ↓ Number of DUIs

Over / Under Compensation
Affected by:
- **↑** Gender (Female)
- **↑** Speeding
- **↑** DUI
- ↓ MBAC

Improper Driving
Affected by:
- **↓** MBAC
- ↑ DUI
- ↑ Gender (Female)
- ↑ Number of Improper Driving

Inexperience
Affected by:
- **↑** Gender (Female)
- **↑** Age (Younger)
- **↓** MBAC
- ↓ Number of DUIs

Other Improper Driving
Affected by:
- ↓ MBAC
- ↑ DUI
- ↑ Number of Improper Driving

Crash Outcomes

Injury Severity
Affected by:
- **↑** DUI
- **↓** Number of DUIs
- ↑ Speeding
- ↑ Inexperience
- ↓ MBAC
- ↑ Gender (Female)
- ↑ Age (Older)

Fatality
Affected by:
- **↑** DUI
- **↓** Number of DUIs
- **↑** Speeding
- **↑** Inexperience
- ↑ Over / Under Compensation
- ↑ Gender (Male)
- ↓ MBAC

↑ Stronger direct effect
↑ Weaker direct effect
↓ Weaker inverse effect
↓ Stronger Inverse effect

Figure 8. Findings of Series 1 Models: Effects of Driver Demographics, Records, Choices, and Actions

Driver Demographics & Records	Driver Choices	Driver Actions	Crash Outcomes

Driver Demographics & Records

Age (Older)
Affects:
- ⬆ M License / Permit
- ⬇ Speeding
- ⬇ Inexperience
- ↓ Helmet Use
- ↑ Injury Severity
- ↑ DUI

Gender (Male)
Affects:
- ⬇ Inexperience
- ⬆ DUI
- ⬇ Over / Under Compensation
- ↑ Speeding
- ↓ M License / Permit
- ↑ Improper Driving
- ↓ Injury Severity
- ↑ Fatality

Number of DUIs
Affects:
- ⬆ DUI
- ⬇ Fatality
- ⬇ Injury Severity
- ↓ Inexperience
- ↓ Speeding

Number of Speeding Violations
Affects:
- ↑ Speeding

Number of Improper Driving Violations
Affects:
- ↑ Improper Driving
- ↑ Other Improper Driving

Number of Sanctions
Affects:
- ↓ Helmet Use

Driver Choices

M License / Permit
Affects:
- ⬆ Helmet Use
- ⬇ DUI
- ⬇ Improper Driving
- ⬇ Inexperience
- ↓ Other Improper Driving
- ↓ Injury Severity
- ↓ Fatality
- ↓ Over / Under Compensation

DUI
Affects:
- ⬆ Fatality
- ⬆ Injury Severity
- ⬆ Speeding
- ⬆ Over / Under Compensation
- ⬇ Helmet Use
- ↑ Improper Driving

Driver Actions

Speeding
Affects:
- ⬆ Over / Under Compensation
- ⬆ Fatality
- ↑ Injury Severity

Over / Under Compensation
Affects:
- ↑ Fatality
- ↑ Injury Severity

Improper Driving

Inexperience
Affects:
- ⬆ Fatality
- ↑ Injury Severity
- ↓ DUI

Other Improper Driving
Affects:
- ↓ Helmet Use

Crash Outcomes

Injury Severity

Fatality

- ⬆ Stronger direct effect
- ↑ Weaker direct effect
- ↓ Weaker inverse effect
- ⬇ Stronger Inverse effect

Series 2 Models

Series 2 models listed in Tables 5a through 5e were tested on each of five subsets of Data Set 3: (1) 8 models of single vehicle crashes; (2) 8 models of multiple vehicle crashes; (3) 8 models of sport/street bike crashes; (4) 8 models of cruiser crashes; and (5) 8 models of crashes of unknown motorcycle types. These 40 models were tested on the "PAMSP era" subset of crashes of Data Set 3. We were provided PAMSP records for 2004 through 2007, and we therefore included only Pennsylvania motorcycle drivers with an initial MBAC date during this period in Series 2 analyses. This was necessary because we do not know which drivers may have received PAMSP training prior to 2004. In order to fairly compare drivers with vs. without PAMSP training, we needed a sample of drivers who began driving a motorcycle in 2004 or later. Application of this criterion allowed us to be reasonably confident that these drivers were not driving motorcycles and did not attend PAMSP training courses prior to 2004.

Series 2 Single Vehicle Crash Models. Eight models were tested on single vehicle crashes. As shown in Table 15a, each model included a distinct set of variables. For example, Models 57 and 58 tested the effects on crash outcomes of the contributing driver actions of *speeding* and *over/under-compensation on a curve*. Model 57 included the crash outcome of *severity of injuries* to the motorcycle drivers, and Model 58 included the crash outcome of motorcycle driver *fatalities*. All Series 2 models included the driving record variable of *number of sanctions*, as well as *PAMSP pass* and d*river's age*. Models 57 and 58 also included the driving record variables of *number of DUI violations* and *number of speeding violations*. (Note that driving records show violations for any vehicle driven; type of vehicle, whether motorcycle or otherwise, is not recorded.) Models 59 and 60 included the focal contributing driver action of *improper driving*, Models 61 and 62 included the focal contributing driver action of *driver inexperience*, and Models 63 and 64 included the focal contributing driver action of *other improper driving*.

*Models 57 and 58: Driving Records, Speeding, Severity of Injuries, and Fataltie*s*.* Models 57 and 58 tested relationships among: (a) a motorcycle driver's history regarding specific types of violations (i.e., speeding and DUI convictions); (b) whether the driver passed a PAMSP course, either BRC or ERC; (c) the driver's age at the time of the crash; (c) whether speeding, over/under-compensating on a curve, DUI, and helmet use were factors in the crash; and (d) crash outcomes including severity of driver injuries (Model 57) and fatalities (Model 58).

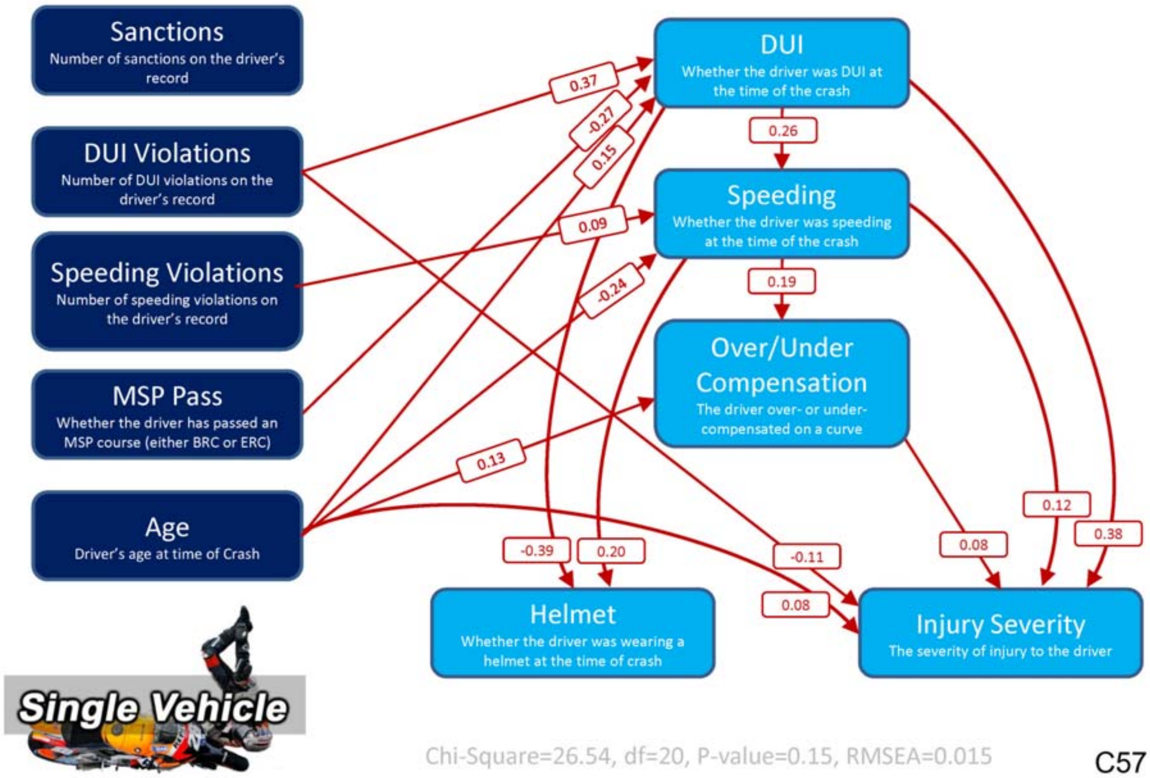
Model 57 shows results for 1,506 single vehicle crashes, with severity of driver injuries as the crash outcome, speeding, over/under-compensating, DUI, and helmet use as crash factors, and driving records, PAMSP pass, and age as antecedent factors. A total of five variables in the model directly influenced injury severity. In descending order of magnitude of influence, these are: DUI at the time of the crash, speeding at the time of the crash, number of DUI violations on record, over/under-compensating on a curve, and driver age. The path coefficient for DUI at the time of the crash (.38) reveals that it had the greatest influence of any of these variables, such that DUI drivers were likely to be

Table 15a. Series 2 Models for Single Vehicle Motorcycle Crashes and PAMSP Training, 2004-2007

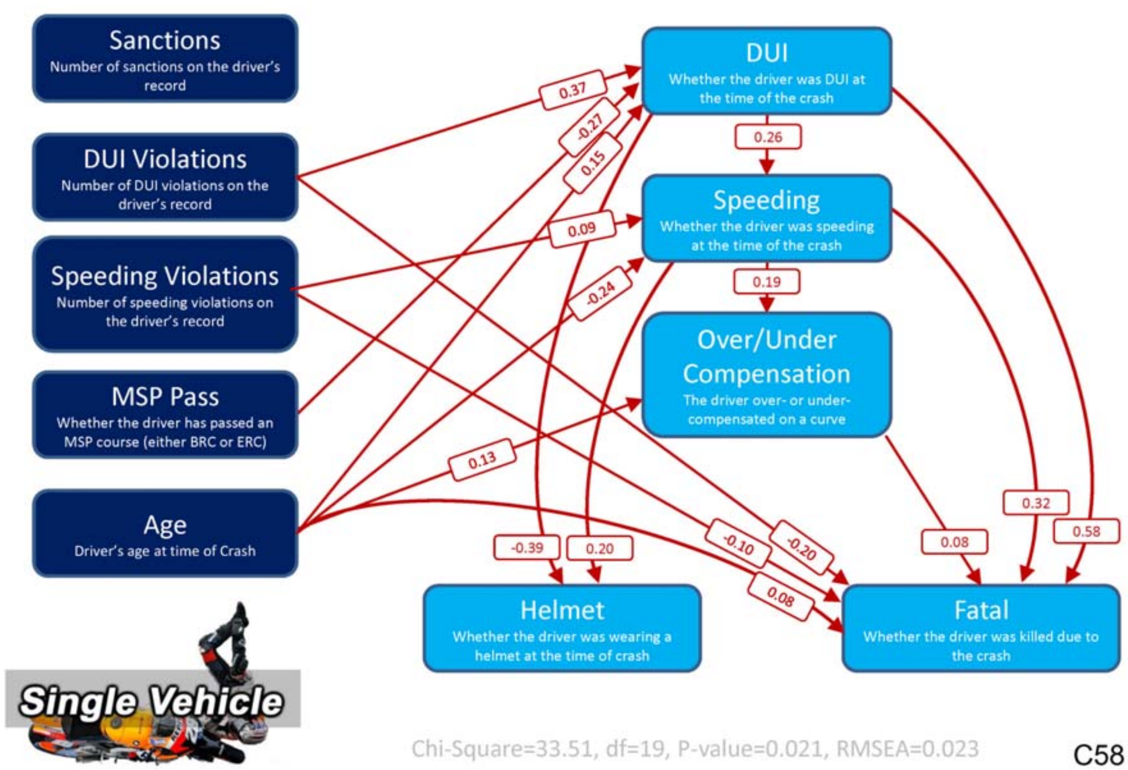
Single Vehicle Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
57	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
58	Driver Fatality		
59	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
60	Driver Fatality		
61	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
62	Driver Fatality		
63	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
64	Driver Fatality		

Note. Number of Crashes: 1,506 for all Models.

Model 57. Driving Record, PAMSP, Driver Actions, Severity



Model 58. Driving Record, PAMSP, Driver Actions, Fatality



more severely injured than non-DUI drivers. Drivers who were speeding (.12) were also likely to be more severely injured than non-speeding drivers. Drivers who over- or under-compensated on a curve (.09) were likely to be more severely injured than drivers who did not. Older drivers were likely to be more severely injured than younger drivers (.08). Drivers with records of DUI violations were likely to be less severely injured than drivers without such records (-.11) – as explained above in the discussion of Model 1, this probably indicates that some drivers with a history of DUI violations avoided speeding when they were drunk-riding to avoid being caught for DUI. When they nevertheless crashed, they did so at lower speeds than other DUI drivers, thus mitigating crash outcomes.

DUI at time of crash plays a central role in Model 57 (and in all other crash models tested). In addition to greater likelihood of severe injury, DUI drivers were more likely to speed (.26) and less likely to wear a helmet (-.39) at the time of the crash. Three antecedent factors in the model influenced DUI at the time of the crash: number of DUI violations on record (.37), MPS pass (-.27), and driver age (.15). Drivers with DUI convictions on record were substantially more likely to crash while DUI than drivers without DUI convictions. Considering that the probability of being caught for DUI is small, it may be that drivers who crash while DUI frequently ride in this condition. Drivers who passed a PAMSP course (BRC, ERC, or both) were less likely to crash while DUI than drivers who did not take or pass a PAMSP course. Older drivers were more likely to be DUI than younger drivers.

There was a small positive relationship between number of speeding violations on record and the likelihood of speeding at the time of the crash (.09), suggesting that drivers who regularly exceeded the speed limits also did so when riding. Younger drivers were more likely to speed (-.24) than older drivers, as were DUI drivers (.26). Speeding drivers (.20) were more likely to wear a helmet, and DUI drivers (-.39) were less likely to wear a helmet at the time of the crash.

Model 58 shows results for 1,506 single vehicle crashes, with driver fatalities as the crash outcome variable. The paths in this model are the same as those shown in Model 57, with one exception. A path showing an inverse relationship between number of speeding violations and fatalities (-.10) is present. Another noteworthy difference between Models 57 and 58 concerns the magnitudes of the path coefficients for variables that directly influence fatalities. DUI (.58) and speeding (.32) at the time of the crash have even greater influences on driver fatalities than on severity of injuries. That is, not only are DUI and speeding drivers likely to be more severely injured, they are even more likely to be killed than non-DUI and non-speeding drivers who crash. As noted above, some drivers who have records of DUI violations avoid speeding, probably to avoid getting caught for DUI; these drivers are even less likely to be killed in a crash (-.20).

Models 59 through 96: Single Vehicle, Multiple Vehicle, Sport Bike, Cruiser, and Unknown Bike Type Crashes. Models 59 through 96 are presented in Appendix G, including the remaining models listed in Table 15a for single vehicle crashes with contributing driver actions of *improper driving*, *driver inexperience*, and *other improper* *driving*, the multiple vehicle crash models listed in Table 15b, the sport/street bike crash models listed in Table 15c, the cruiser crash models listed in Table 15d, and the unknown bike type crash models listed in Table 15e. These models are not discussed in detail here because of the large number of models and path coefficients. There are substantial consistencies in findings across these models, however, as well as variations according to breakdown variables that are quite informative. We summarize these findings in the next section.

Findings of Series 2 Models

The findings of the Series 2 models for motorcycle crashes of drivers who obtained an MBAC between 2004 and 2007 are summarized in Tables 16 through 24. These tables show the factors that influenced crash outcomes (severity of driver injuries and fatalities) and driver actions (DUI, speeding, helmet use, driver inexperience, over-/under-compensation on a curve, improper driving, and other improper driving). The tables are designed to facilitate comparisons across breakdown variables (single and multiple vehicle crashes, sport/street bike, cruiser, and unknown bike type crashes) and across contributing factors (driver actions, driver choices, driving record, and driver demographics). Each cell presents the average path coefficient, the number of statistically significant paths relative to the number of models in which the path was tested, and the range of path coefficients across models in which the path was tested.

Table 16: Contributors to Severity of Driver Injuries. The first row of Table 16 shows the effects of DUI on severity of driver injuries for single and multiple vehicle crashes, and for sport bike, cruiser, and unknown bike type crashes. All values are positive, indicating that drivers who were DUI at the time of the crash were likely to sustain more severe injuries than drivers who were not DUI. The average path coefficient is greater for single vehicle crashes (.42) than for multiple vehicle crashes (.35), indicating that DUI played a somewhat greater role in determining injury severity in the former vs. the latter crashes. Comparing types of motorcycles, DUI played a somewhat greater role in determining injury severity in cruiser (.44) and sport bike crashes (.43) as compared to unknown bike type crashes (.26).

Other findings shown in Table 16 are also noteworthy. Speeding influenced injury severity, such that speeding drivers were more severely injured than drivers who were not speeding, especially for multiple (.22) vs. single vehicle crashes (.12). Speeding had the greatest influence on injury severity for sport bike crashes (.23), and the least for cruiser crashes (.08). Compared to DUI, speeding played a lesser role in determining injury severity. Over- or under-compensation on a curve also contributed to injury severity for single vehicle crashes.

Inexperienced drivers tended to suffer somewhat more severe injuries than experienced drivers (values ranged from .07 for sport bikes to .17 for cruisers). Driver actions of improper driving (-.09) and other improper driving (-.16) were negatively related to injury severity for multiple vehicle crashes, but not single vehicle crashes. Investigating officers tended to attribute crashes to these driver actions when injuries were less severe.

Table 15b. Series 2 Models for Multiple Vehicle Crashes and PAMSP Training, 2004-2007

Multiple Vehicle Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
65	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
66	Driver Fatality		
67	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
68	Driver Fatality		
69	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
70	Driver Fatality		
71	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
72	Driver Fatality		

Note. Number of Crashes: 1,425 for all Models.

Table 15c. Series 2 Models for Sport Bike Crashes and PAMSP Training, 2004-2007

Sport Bike Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
73	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
74	Driver Fatality		
75	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
76	Driver Fatality		
77	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
78	Driver Fatality		
79	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
80	Driver Fatality		

Note. Number of Crashes: 831 for all Models. Models 79 and 80 did not produce proper statistical solutions and are not included in Appendix G.

Table 15d. Series 2 Models for Cruiser Crashes and PAMSP Training, 2004-2007

Cruiser Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
81	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
82	Driver Fatality		
83	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
84	Driver Fatality		
85	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
86	Driver Fatality		
87	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
88	Driver Fatality		

Note. Number of Crashes: 869 for all Models.

Table 15e. Series 2 Models for Unknown Bike Type Crashes and PAMSP Training, 2004-2007

Unknown Bike Type Crashes			
Model	**Crash Outcomes**	**Crash Factors**	**Antecedent Factors**
89	Driver Injury Severity	Speeding Over/Under Compensation DUI Helmet Use	Number of Sanctions Number of Speeding Violations Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
90	Driver Fatality		
91	Driver Injury Severity	DUI Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
92	Driver Fatality		
93	Driver Injury Severity	DUI Inexperience Helmet Use	Number of Sanctions Number of DUI Violations PAMSP Pass Driver's Age (at time of crash)
94	Driver Fatality		
95	Driver Injury Severity	DUI Other Improper Driving Helmet Use	Number of Sanctions Number of DUI Violations Number of Improper Driving Violations PAMSP Pass Driver's Age (at time of crash)
96	Driver Fatality		

Note. Number of Crashes: 1,144 for all Models.

Table 16. Contributors to Injury Severity, Series 2 Models 2004-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Demographics	Driver Age	.08 (1/4, .08 to .08)	-.08 (2/4, -.08 to -.07)	-	-	-
Driver Actions	DUI	.42 (4/4, .38 to .46)	.35 (4/4, .26 to .4)	.43 (3/4, .33 to .49)	.44 (4/4, .39 to .51)	.26 (4/4, .25 to .29)
Driver Actions	Speeding	.12 (1/1, .12 to .12)	.22 (1/1, .22 to .22)	.23 (1/1, .23 to .23)	.08 (1/1, .08 to .08)	.09 (1/1, .09 to .09)
Driver Actions	Under/Over Compensation	.08 (1/1, .08 to .08)	-	-	-	.20 (1/1, .2 to .2)
Driver Actions	Improper Driving	-	-.09 (1/1, -.09 to -.09)	.11 (1/1, .11 to .11)	-	-
Driver Actions	Inexperience	.11 (1/1, .11 to .11)	.15 (1/1, .15 to .15)	.07 (1/1, .07 to .07)	.17 (1/1, .17 to .17)	-
Driver Actions	Other Improper Driving	-	-.16 (1/1, -.16 to -.16)	-	-	-
Driver Choices	Helmet	-	-	.13 (2/4, .12 to .14)	-	-.11 (4/4, -.15 to -.09)
Driver Choices	PAMSP Pass	-	.06 (1/4, .06 to .06)	-	.09 (1/4, .09 to .09)	-
Driving Record	Number of Sanctions	-	-	-	-	-.07 (1/4, -.07 to -.07)
Driving Record	Number of DUIs	-.11 (4/4, -.12 to -.11)	-.11 (4/4, -.13 to -.09)	-.20 (3/4, -.22 to -.17)	-.10 (4/4, -.1 to -.09)	-.10 (4/4, -.13 to -.09)
Driving Record	Number of Speeding	-	-	-	-	-
Driving Record	Number of Improper Driving	-	-	-	-	.09 (1/2, .09 to .09)

Note. Blank cells indicate non-significant contributors/model paths.

Helmet use showed a small negative relationship to injury severity for unknown bike type crashes (-.11), but a positive relationship for sport bike crashes (.13). Wearing a helmet tended to mitigate injury severity for the former, but exacerbate it for the latter crashes.

Number of DUI convictions on a driver's record displayed moderately negative relationships to injury severity, with path coefficients ranging from -.10 to -.20. Drivers with DUI convictions tended to be less severely injured. As noted earlier, these drivers also tended to be DUI in their crashes, and may have been driving more slowly to avoid being stopped for speeding and thus incur another DUI (and associated penalties). Their injuries were mitigated because they crashed at lower speeds than drivers who were DUI and speeding. It is noteworthy that this effect appeared for all types of crashes.

Table 17: Contributors to Driver Fatalities. Table 17 shows the effects of contributing factors on driver fatalities. Several findings regarding driver fatalities as distinct from injury severities are noteworthy. First, the strongest effects in Table 16 are even stronger in Table 17. DUI plays a greater role in crash fatalities than injuries for both single (.69 vs. .42) and multiple (.65 vs. .35) vehicle crashes, and for cruiser crashes (.86 vs. .44). Speeding also plays a greater role in fatalities than injuries (single vehicle, .32 vs. .12; multiple vehicle, .37 vs. .22; sport bikes, .33 vs. .23; unknown bike types, .50 vs. .09). Helmet use slightly increases the likelihood of fatalities for both single (.09) and multiple (.13) vehicle crashes. Passing a PAMSP course increases the likelihood of fatalities in single (.07) and multiple (.24) vehicle crashes, and in cruiser (.24) and unknown bike type (.21) crashes. However, passing a PAMSP course decreases the likelihood of fatalities in sport bike crashes (-.11).

Table 18: Contributors to DUI at Time of Crash. DUI plays an important role in crash outcomes. Table 18 summarizes factors that affect whether or not a driver is DUI at the time of the crash. The strongest influence on DUI at crash is the number of DUI convictions on a driver's record (values ranged from .26 for cruiser crashes to .48 for unknown bike type crashes). For some drivers, DUI is a consistent behavior that contributes to the severity of crash outcomes. As shown by analyses of Data Set 1 presented in Table 2 (Analysis 2), a history of DUI convictions may also increase the likelihood of a crash.

Drivers who passed a PAMSP course were substantially less likely to be DUI than drivers who did not take or pass a PAMSP course (values ranged from -.29 for single vehicle and sport bike crashes to -.41 for unknown bike type crashes). Drivers who were described by investigating officers as inexperienced were less likely to be DUI (values ranged from -.11 for unknown bike type crashes to -.32 for single vehicle and cruiser crashes). Older drivers were somewhat more likely to be DUI at crash than younger drivers (values ranged from .14 for unknown bike type crashes to .20 for multiple vehicle crashes).

Table 19: Contributors to Speeding at Time of Crash. Several factors increased the likelihood of speeding at the time of the crash. Chief among these was DUI. DUI drivers were more likely to be speeding, regardless of type of crash (single vehicle = .26; multiple vehicle = .35) or motorcycle (sport bikes = .32; cruisers = .47; unknown bike

Table 17. Contributors to Fatality, Series 2 Models 2004-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Demo-graphics	Driver Age	.08 (1/4, .08 to .08)	-.14 (3/4, -.18 to -.08)	-	.07 (3/4, .06 to .08)	.09 (1/4, .09 to .09)
Driver Actions	DUI	.69 (4/4, .58 to .74)	.65 (4/4, .45 to .73)	.42 (3/4, .29 to .54)	.86 (4/4, .81 to .91)	.16 (4/4, .1 to .26)
	Speeding	.32 (1/1, .32 to .32)	.37 (1/1, .37 to .37)	.33 (1/1, .33 to .33)	.07 (1/1, .07 to .07)	.50 (1/1, .5 to .5)
	Under/Over Compensation	.08 (1/1, .08 to .08)	-	-	-.07 (1/1, -.07 to -.07)	-.11 (1/1, -.11 to -.11)
	Improper Driving	-	-.21 (1/1, -.21 to -.21)	.13 (1/1, .13 to .13)	-.09 (1/1, -.09 to -.09)	.12 (1/1, .12 to .12)
	Inexperience	.07 (1/1, .07 to .07)	.30 (1/1, .3 to .3)	-	.22 (1/1, .22 to .22)	.10 (1/1, .1 to .1)
	Other Improper Driving	-.09 (1/1, -.09 to -.09)	-.21 (1/1, -.21 to -.21)	-	-.27 (1/1, -.27 to -.27)	.23 (1/1, .23 to .23)
Driver Choices	Helmet	.09 (3/4, .09 to .1)	.13 (3/4, .11 to .15)	.11 (1/4, .11 to .11)	.06 (1/4, .06 to .06)	-.13 (4/4, -.14 to -.12)
	PAMSP Pass	.07 (2/4, .06 to .08)	.24 (4/4, .18 to .29)	-.11 (2/4, -.11 to -.11)	.24 (4/4, .21 to .28)	.21 (4/4, .18 to .24)
Driving Record	Number of Sanctions	-	-	-.11 (2/4, -.11 to -.1)	-	-.08 (2/4, -.09 to -.07)
	Number of DUIs	-.22 (4/4, -.23 to -.2)	-.18 (4/4, -.2 to -.14)	-.15 (3/4, -.17 to -.13)	-.22 (4/4, -.22 to -.2)	-.08 (1/4, -.08 to -.08)
	Number of Speeding	-.10 (1/1, -.1 to -.1)	-	-	-	-.15 (1/1, -.15 to -.15)
	Number of Improper Driving	-.07 (1/2, -.07 to -.07)	-.05 (1/2, -.05 to -.05)	-	-.07 (1/2, -.07 to -.07)	-.11 (1/2, -.11 to -.11)

Note. Blank cells indicate non-significant contributors/model paths.

Table 18. Contributors to DUI, Series 2 Models 2004-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	-	-	-	-	-
Driver Actions	Speeding	-	-	-	-	-
Driver Actions	Under/Over Compensation	-	-	-	-	-
Driver Actions	Improper Driving	-	-	-	-	-
Driver Actions	Inexperience	-.32 (1/1, -.32 to -.32)	-.20 (1/1, -.2 to -.2)	-.20 (1/1, -.2 to -.2)	-.32 (1/1, -.32 to -.32)	-.11 (1/1, -.11 to -.11)
Driver Actions	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
Driver Choices	PAMSP Pass	-.29 (4/4, -.32 to -.27)	-.39 (4/4, -.4 to -.38)	-.29 (3/4, -.32 to -.27)	-.36 (4/4, -.39 to -.35)	-.41 (4/4, -.42 to -.41)
Driving Record	Number of Sanctions	.06 (1/4, .06 to .06)	-.05 (2/4, -.05 to -.05)	.12 (3/4, .1 to .17)	-.09 (1/4, -.09 to -.09)	-
Driving Record	Number of DUIs	.37 (4/4, .35 to .38)	.31 (4/4, .3 to .31)	.44 (3/4, .43 to .45)	.26 (4/4, .26 to .27)	.48 (4/4, .48 to .48)
Driving Record	Number of Speeding	-	-	-	-	-
Driving Record	Number of Improper Driving	-.09 (1/2, -.09 to -.09)	-	-.17 (1/2, -.17 to -.17)	-	-
Driver Demo-graphics	Driver Age	.15 (4/4, .15 to .16)	.20 (4/4, .16 to .21)	.15 (3/4, .15 to .16)	-	.14 (4/4, .14 to .14)

Note. Blank cells indicate non-significant contributors/model paths.

Table 19. Contributors to Speeding, Series 2 Models 2004-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	.26 (1/1, .26 to .26)	.35 (1/1, .35 to .35)	.32 (1/1, .32 to .32)	.47 (1/1, .47 to .47)	.16 (1/1, .16 to .16)
	Speeding	-	-	-	-	-
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-	-	-	-	-
	Inexperience	-	-	-	-	-
	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
	PAMSP Pass	-	-	-	-	-
Driving Record	Number of Sanctions	-	-	-	-	-
	Number of DUIs	-	-.10 (1/1, -.1 to -.1)	-	-	-
	Number of Speeding	.09 (1/1, .09 to .09)	.07 (1/1, .07 to .07)	.08 (1/1, .08 to .08)	-	.09 (1/1, .09 to .09)
	Number of Improper Driving	-	-	-	-	-
Driver Demo-graphics	Driver Age	-.24 (1/1, -.24 to -.24)	-.32 (1/1, -.32 to -.32)	-.13 (1/1, -.13 to -.13)	-	-.26 (1/1, -.26 to -.26)

Note. Blank cells indicate non-significant contributors/model paths.

type = .16). Second in importance was driver age – younger drivers were more likely to be speeding in single (-.24) and multiple (-.32) vehicle crashes, and in sport bike (-.13) and unknown bike type (-.26) crashes. A driver's record of speeding convictions also increased the likelihood of speeding (values ranged from .07 to .09), suggesting that speeding, like DUI, is a reliable behavior that probably occurs on a regular basis for some drivers.

Table 20: Contributors to Helmet Use at Time of Crash. Several factors affected the likelihood of wearing a helmet at the time of the crash. Chief among these was DUI -- DUI drivers were less likely to wear a helmet than non-DUI drivers, especially in sport bike crashes (-.59). Speeding drivers were consistently more likely to wear a helmet (values ranged from .14 for unknown bike type crashes to .30 for sport bike crashes). Inexperienced drivers were somewhat more likely to wear a helmet (values ranged from .06 for single vehicle crashes to .17 for unknown bike type crashes). Drivers who passed a PAMSP course were less likely to wear a helmet in multiple vehicle (-.13) and sport bike (-.21) crashes.

Table 21: Contributors to Driver Inexperience. Drivers who passed a PAMSP course were less likely than drivers who did not take or pass a PAMSP course to be rated inexperienced by investigating officers (values ranged from -.10 for cruiser crashes to -.27 for sport bike crashes).

Table 22: Contributors to Over/Under-compensation on a Curve. Drivers who were speeding were more likely to over- or under-compensate on a curve (values ranged from .18 for cruiser crashes to .34 for unknown bike type crashes), except in multiple vehicle crashes. Older drivers were more likely to over- or under-compensate (values ranged from .09 for cruiser crashes to .21 for unknown bike type crashes), except for multiple vehicle crashes.

Table 23: Contributors to Improper Driving at Time of Crash. DUI drivers were more likely to drive improperly, especially in multiple vehicle crashes (.37). Older drivers were less likely to drive improperly, especially in multiple vehicle crashes (-.20).

Table 24: Contributors to Other Improper Driving at Time of Crash. Number of improper driving violations on record slightly increased the likelihood of other improper driving (single vehicle crashes = .07; multiple vehicle crashes = .12; unknown bike type crashes = .19). Older drivers were somewhat less likely than younger drivers to engage in other improper driving (single vehicle crashes = -.10; multiple vehicle crashes = -.13; unknown bike type crashes = -.11).

Summary of Findings of Series 2 Models

Figures 9 and 10 summarize the findings of the Series 2 models. Figure 9 shows the variables that affect each factor (driver choices, driver actions, and crash outcomes).

Table 20. Contributors to Helmet Use, Series 2 Models 2004-2007

		(3/4, -.11 to - .1)		Type of Crash		
	Contributing Factor	Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	-.34 (4/4, -.39 to - .31)	-.39 (4/4, -.44 to - .33)	-.59 (3/4, -.64 to - .54)	-.30 (4/4, -.37 to - .24)	-.24 (4/4, -.28 to - .21)
	Speeding	.20 (1/1, .2 to .2)	.21 (1/1, .21 to .21)	.30 (1/1, .3 to .3)	.17 (1/1, .17 to .17)	.14 (1/1, .14 to .14)
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-.14 (1/1, -.14 to - .14)	.11 (1/1, .11 to .11)	-.18 (1/1, -.18 to - .18)	-	-
	Inexperience	.06 (1/1, .06 to .06)	.08 (1/1, .08 to .08)	-	.15 (1/1, .15 to .15)	.17 (1/1, .17 to .17)
	Other Improper Driving	-	.06 (1/1, .06 to .06)	-	.11 (1/1, .11 to .11)	.08 (1/1, .08 to .08)
Driver Choices	Helmet	-	-	-	-	-
	PAMSP Pass	-	-.13 (4/4, -.14 to - .11)	-.21 (3/4, -.22 to - .21)	-	-
Driving Record	Number of Sanctions	-.05 (1/4, -.05 to - .05)	-.12 (4/4, -.13 to - .11)	-	-	-.12 (4/4, -.13 to - .11)
	Number of DUIs	-	.10 (2/4, .09 to .1)	.23 (3/4, .21 to .26)	-	.12 (3/4, .11 to .13)
	Number of Speeding	-	-	-.13 (1/1, -.13 to - .13)	-	-
	Number of Improper Driving	-	-	-	-	-
Demo - graph	Driver Age	-.11	-	-	-	-

Note. Blank cells indicate non-significant contributors/model paths.

Table 21. Contributors to Inexperience, Series 2 Models 2004-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	-	-	-	-	-
	Speeding	-	-	-	-	-
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-	-	-	-	-
	Inexperience	-	-	-	-	-
	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
	PAMSP Pass	-.13 (1/1, -.13 to -.13)	-.15 (1/1, -.15 to -.15)	-.27 (1/1, -.27 to -.27)	-.10 (1/1, -.1 to -.1)	-.15 (1/1, -.15 to -.15)
Driving Record	Number of Sanctions	-	-	-	-.10 (1/1, -.1 to -.1)	-.12 (1/1, -.12 to -.12)
	Number of DUIs	-	-	-	-	-
	Number of Speeding	-	-	-	-	-
	Number of Improper Driving	-	-	-	-	-
Driver Demo-graphics	Driver Age	-	-.24 (1/1, -.24 to -.24)	-	-.07 (1/1, -.07 to -.07)	-

Note. Blank cells indicate non-significant contributors/model paths.

Table 22. Contributors to Over/Under Compensation, Series 2 Models 2004-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	-	-	-	.15 (1/1, .15 to .15)	-.43 (1/1, -.43 to -.43)
Driver Actions	Speeding	.19 (1/1, .19 to .19)	-	.33 (1/1, .33 to .33)	.18 (1/1, .18 to .18)	.34 (1/1, .34 to .34)
Driver Actions	Under/Over Compensation	-	-	-	-	-
Driver Actions	Improper Driving	-	-	-	-	-
Driver Actions	Inexperience	-	-	-	-	-
Driver Actions	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	.18 (1/1, .18 to .18)
Driver Choices	PAMSP Pass	-	-	-.11 (1/1, -.11 to -.11)	-	-.20 (1/1, -.2 to -.2)
Driving Record	Number of Sanctions	-	-	-	-	-
Driving Record	Number of DUIs	-	-	-	-	.27 (1/1, .27 to .27)
Driving Record	Number of Speeding	-	-	-	-	-
Driving Record	Number of Improper Driving	-	-	-	-	-
Driver Demo-graphics	Driver Age	.13 (1/1, .13 to .13)	-	.14 (1/1, .14 to .14)	.09 (1/1, .09 to .09)	.21 (1/1, .21 to .21)

Note. Blank cells indicate non-significant contributors/model paths.

Table 23. Contributors to Improper Driving, Series 2 Models 2004-2007

	Contributing Factor	Type of Crash: Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	-	.37 (1/1, .37 to .37)	-.21 (1/1, -.21 to -.21)	.10 (1/1, .1 to .1)	.21 (1/1, .21 to .21)
Driver Actions	Speeding	-	-	-	-	-
Driver Actions	Under/Over Compensation	-	-	-	-	-
Driver Actions	Improper Driving	-	-	-	-	-
Driver Actions	Inexperience	-	-	-	-	-
Driver Actions	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
Driver Choices	PAMSP Pass	-	.19 (1/1, .19 to .19)	-	-	-
Driving Record	Number of Sanctions	-	-	-	-	-
Driving Record	Number of DUIs	-	-	-	-	-
Driving Record	Number of Speeding	-	-	-	-	-
Driving Record	Number of Improper Driving	-	-	-	.11 (1/1, .11 to .11)	-
Driver Demographics	Driver Age	-	-.20 (1/1, -.2 to -.2)	-.08 (1/1, -.08 to -.08)	-	-.09 (1/1, -.09 to -.09)

Note. Blank cells indicate non-significant contributors/model paths.

Table 24. Contributors to Other Improper Driving, Series 2 Models 2004-2007

	Contributing Factor	Type of Crash				
		Single Vehicle	Multiple Vehicle	Sport Bike	Cruisers	Unknown Bike Type
Driver Actions	DUI	.12 (1/1, .12 to .12)	.34 (1/1, .34 to .34)	-	.12 (1/1, .12 to .12)	.59 (1/1, .59 to .59)
	Speeding	-	-	-	-	-
	Under/Over Compensation	-	-	-	-	-
	Improper Driving	-	-	-	-	-
	Inexperience	-	-	-	-	-
	Other Improper Driving	-	-	-	-	-
Driver Choices	Helmet	-	-	-	-	-
	PAMSP Pass	-	-	-	-.09 (1/1, -.09 to -.09)	.18 (1/1, .18 to .18)
Driving Record	Number of Sanctions	-	-	-	-	-
	Number of DUIs	-.08 (1/1, -.08 to -.08)	-.14 (1/1, -.14 to -.14)	-	-	-.32 (1/1, -.32 to -.32)
	Number of Speeding	-	-	-	-	-
	Number of Improper Driving	.07 (1/1, .07 to .07)	.12 (1/1, .12 to .12)	-	-	.19 (1/1, .19 to .19)
Driver Demo-graphics	Driver Age	-.10 (1/1, -.1 to -.1)	-.13 (1/1, -.13 to -.13)	-	-	-.11 (1/1, -.11 to -.11)

Note. Blank cells indicate non-significant contributors/model paths.

- Bold upward arrows indicate stronger direct effects of one variable on the other. For example, a greater number of DUI convictions substantially *increased* the likelihood that a driver was DUI at the time of the crash.
- Non-bold upward arrows indicate weaker direct effects. For example, females were somewhat *more* likely than males to have an MBAC.
- Bold downward arrows indicate stronger inverse effects. For example, drivers with an MBAC were substantially *less* likely to be DUI at the time of the crash than drivers without an MBAC.
- Non-bold downward arrows indicate weaker inverse effects. For example, drivers with an MBAC were somewhat *less* likely to be killed in a crash than drivers without an MBAC.

Bold arrows correspond to average path coefficients associated with a factor of .15 or greater, non-bold arrows correspond to average path coefficients associated with a factor of less than .15. Figure 10 summarizes the same findings as Figure 9, but organizes them according to the variables that each factor affects.

Contributing Factors to Crashes: Proportions DUI, Speeding, and MBAC

The findings of Series 1 and 2 Models show that DUI and speeding played important roles in crash outcomes. In addition to relative strength and direction of influences, as summarized in Tables 6 – 24 and Figures 7 – 10, it is important to examine numbers and proportions of drivers who suffered consequences of these choices and actions. Tables 25 and 26 summarize this information.

Table 25 shows numbers of fatal and non-fatal crashes for all crashes from 1997 – 2007, and for breakdowns by single vs. multiple vehicle crashes and by sport bike, cruiser, and unknown bike type crashes (column 2). (Fatalities are for motorcycle drivers only; note that the *all crash* category includes sport bike, cruiser, and unknown bike types, as well as dual-sport, off-road, scooter/moped, and mini-bike crashes – the latter categories are not shown as separate columns in Table 25 due to small numbers of crashes per category.) Associated percentages relative to totals are shown in column 3 (total crashes by category are given in the table note). Thus, reading down column 2, fatal crashes range from 4% to 6% of crashes across categories, and, conversely, non-fatal crashes range from 94% to 96%.

Column 4 of Table 25 reports the numbers of drivers in fatal and non-fatal crashes who were DUI at the time of the crash, and column 5 shows the associated percentages, calculated as the number DUI divided by the number of crashes shown in the same row. Thus, of 1,263 fatal crashes (shown in the first row of data), 405 of these drivers were DUI at the time of the crash, or 32%. This compares to only 4% of drivers involved in all non-fatal crashes who were DUI. Although the number of DUI drivers involved in all non-fatal crashes (980) is more than twice as large as the number of DUI drivers in all fatal crashes (405), the percent of DUI drivers in non-fatal crashes is much lower than the percent of DUI drivers in fatal crashes because of the much larger number of non-fatal (23,848) vs. fatal (1,263) crashes. This dramatic difference in the proportions of drivers

Figure 9. Findings of Series 2 Models: Effects on Driver Choices, Driver Actions, and Crash Outcomes

Driver Demographics & Records	Driver Choices	Driver Actions	Crash Outcomes
Age **MSP Pass** **Number of DUIs** **Number of Speeding Violations** **Number of Improper Driving Violations** **Number of Sanctions**	**DUI** Affected by: ⬆ Number of DUIs ⬇ MSP Pass ⬇ Inexperience ⬆ Age (Older) **Helmet Use** Affected by: ⬇ DUI ⬆ Speeding ↑ Number of DUIs ↑ Inexperience ↑ Other Improper Driving	**Speeding** Affected by: ⬆ DUI ⬆ Age (Younger) ↑ Number of Speeding Violations **Over / Under Compensation** Affected by: ⬆ Speeding ↑ Age (Older) **Improper Driving** Affected by: ⬆ DUI ↑ Age (Younger) **Inexperience** Affected by: ⬇ MSP Pass **Other Improper Driving** Affected by: ⬆ DUI ↓ Number of DUIs ↑ Number of Improper Driving ↑ Age (Younger)	**Injury Severity** Affected by: ⬆ DUI ⬆ Speeding ↓ Number of DUIs ↑ Inexperience **Fatality** Affected by: ⬆ DUI ⬆ Speeding ⬇ Number of DUIs ⬆ Inexperience ↓ Other Improper Driving ↑ MSP Pass ↑ Helmet Use ↓ Number of Improper Driving ↑ Age (Older) ⬆ Stronger direct effect ↑ Weaker direct effect ↓ Weaker inverse effect ⬇ Stronger Inverse effect

Figure 10. Findings of Series 2 Models: Effects of Driver Demographics, Records, Choices, and Actions

Driver Demographics & Records → Driver Choices → Driver Actions → Crash Outcomes

Driver Demographics & Records

Age (Older)
Affects:
- **↓** Speeding
- **↑** DUI
- ↑ Over / Under Compensation
- ↓ Improper Driving
- ↓ Other Improper Driving
- ↑ Fatality

MSP Pass
Affects:
- **↓** DUI
- **↓** Inexperience
- ↑ Fatality

Number of DUIs
Affects:
- **↑** DUI
- **↓** Fatality
- ↓ Injury Severity
- ↑ Helmet Use
- ↓ Other Improper Driving

Number of Speeding Violations
Affects:
- ↑ Speeding

Number of Improper Driving Violations
Affects:
- ↑ Other Improper Driving
- ↓ Fatality

Number of Sanctions

Driver Choices

DUI
Affects:
- **↑** Fatality
- **↑** Injury Severity
- **↓** Helmet Use
- **↑** Speeding
- **↑** Other Improper Driving
- **↑** Improper Driving

Helmet Use
Affects:
- ↑ Fatality

Driver Actions

Speeding
Affects:
- **↑** Fatality
- **↑** Over / Under Compensation
- **↑** Helmet Use
- **↑** Injury Severity

Over / Under Compensation

Improper Driving

Inexperience
Affects:
- **↓** DUI
- **↑** Fatality
- ↑ Injury Severity
- ↑ Helmet Use

Other Improper Driving
Affects:
- ↓ Fatality
- ↑ Helmet Use

Crash Outcomes

Injury Severity

Fatality

↑ Stronger direct effect
↑ Weaker direct effect
↓ Weaker inverse effect
↓ Stronger Inverse effect

Table 25. Contributing Factors to Fatal and Non-Fatal Crashes by Major Crash Categories, 1997-2007

	Crashes		DUI at time of Crash		Speeding at time of Crash		MBAC Ever	
Fatal Crashes	Number	Percent of Total	Number	Percent of Fatal	Number	Percent of Fatal	Number	Percent of Fatal
All Crashes	1,263	5%	405	32%	536	42%	1,036	82%
Single Vehicle	536	5%	235	44%	284	53%	444	83%
Multiple Vehicle	727	5%	170	23%	252	35%	592	81%
Sport Bike	289	6%	49	17%	168	58%	226	78%
Cruiser	604	5%	267	44%	203	34%	540	89%
Unknown Bike Type	335	4%	74	22%	159	47%	253	76%
Non-Fatal Crashes	Number	Percent of Total	Number	Percent of Non-Fatal	Number	Percent of Non-Fatal	Number	Percent of Non-Fatal
All Crashes	23,848	95%	980	4%	4,290	18%	21,400	90%
Single Vehicle	11,342	95%	760	7%	3,003	26%	10,123	89%
Multiple Vehicle	12,506	95%	220	2%	1,287	10%	11,277	90%
Sport Bike	4,365	94%	88	2%	1,053	24%	3,870	89%
Cruiser	11,450	95%	650	6%	1,641	14%	10,806	94%
Unknown Bike Type	7,263	96%	219	3%	1,492	21%	6,164	85%

Note. Total Number of Crashes: All - 25,111; Single Vehicle - 11,878; Multiple Vehicle - 13,233; Sport Bike - 4,654; Cruiser - 12,054; Unknown Bike Type - 7,598. Percent of Total = Number of Crashes / Total Number of Crashes (e.g. 1,263 / 25,111 = 5%). Percent of Fatal/Non-Fatal = Number of DUI or Speeding or MBAC / Number of Crashes (e.g. 405 / 1,263 = 32%).

Table 26. Contributing Factors to Crashes, Fatalities and Helmet Use, by Major Crash Categories, 1997-2007

	Crashes		DUI at time of Crash		Speeding at time of Crash		MBAC Ever	
Fatal, Helmet	**Number**	**Percent of Total**	**Number**	**Percent of Fatal, Helmet**	**Number**	**Percent of Fatal, Helmet**	**Number**	**Percent of Fatal, Helmet**
All Crashes	801	4%	236	29%	348	43%	686	86%
Single Vehicle	331	3%	134	40%	184	56%	282	85%
Multiple Vehicle	470	4%	102	22%	164	35%	404	86%
Sport Bike	198	5%	32	16%	120	61%	170	86%
Cruiser	368	3%	149	40%	118	32%	324	88%
Unknown Bike Type	213	3%	44	21%	105	49%	179	84%
Fatal, No Helmet	**Number**	**Percent of Total**	**Number**	**Percent of Fatal, No Helmet**	**Number**	**Percent of Fatal, No Helmet**	**Number**	**Percent of Fatal, No Helmet**
All Crashes	377	2%	141	37%	162	43%	287	76%
Single Vehicle	169	2%	82	49%	87	51%	132	78%
Multiple Vehicle	208	2%	59	28%	75	36%	155	75%
Sport Bike	65	2%	14	22%	37	57%	44	68%
Cruiser	201	2%	97	48%	76	38%	182	91%
Unknown Bike Type	99	1%	26	26%	48	48%	58	59%
Non-Fatal, Helmet	**Number**	**Percent of Total**	**Number**	**Percent of Non-Fatal, Helmet**	**Number**	**Percent of Non-Fatal, Helmet**	**Number**	**Percent of Non-Fatal, Helmet**
All Crashes	15,728	69%	517	3%	2,923	19%	14,622	93%
Single Vehicle	7,733	71%	406	5%	2,074	27%	7,128	92%
Multiple Vehicle	7,995	67%	111	1%	849	11%	7,494	94%
Sport Bike	3,061	75%	65	2%	797	26%	2,809	92%
Cruiser	7,369	67%	332	5%	1,011	14%	7,035	95%
Unknown Bike Type	4,843	69%	112	2%	1,057	22%	4,392	91%
Non-Fatal, No Helmet	**Number**	**Percent of Total**	**Number**	**Percent of Non-Fatal, No Helmet**	**Number**	**Percent of Non-Fatal, No Helmet**	**Number**	**Percent of Non-Fatal, No Helmet**
All Crashes	5,917	26%	384	6%	1,102	19%	4,897	83%
Single Vehicle	2,679	25%	299	11%	749	28%	2,190	82%
Multiple Vehicle	3,238	27%	85	3%	353	11%	2,707	84%
Sport Bike	784	19%	20	3%	180	23%	634	81%
Cruiser	3,020	28%	259	9%	519	17%	2,788	92%
Unknown Bike Type	1,864	27%	91	5%	359	19%	1,348	72%

Note. Total Number of Crashes: All - 22,823; Single Vehicle - 10,912; Multiple Vehicle - 11,911; Sport Bike - 4,108; Cruiser - 10,958; Unknown Bike Type - 7,019. Percent of Total = Number of Crashes / Total Number of Crashes (e.g. 801 / 22,823 = 4%). Percent of Fatal/Non-Fatal = Number of DUI or Speeding or MBAC / Number of Crashes (e.g. 236 / 801 = 29%).

who were DUI in fatal vs. non-fatal crashes (32% vs. 4%) explains why the Series 1 and 2 Models showed such large effects of DUI on crash outcomes.

Column 5 of Table 25 also reveals that the proportions of DUI drivers in fatal crashes varied considerably across crash categories. Drivers in single vehicle fatal crashes were almost twice as likely to be DUI as drivers in multiple vehicle fatal crashes (44% vs. 23%). Drivers in fatal cruiser crashes were twice as likely to be DUI as drivers in unknown bike type fatal crashes (44% vs. 22%), and more than twice as likely to be DUI as sport bike drivers in fatal crashes (44% vs. 17%). Thus, DUI played an important role in fatalities for all types of motorcycle crashes, but the magnitude of influence varied considerably by crash category. The associated numbers of fatalities suggest potential payoffs of efforts to reduce the incidence of DUI among motorcyclists. The biggest potential payoff of a reduction in drunk-riding would occur among cruiser drivers, because they have the greatest incidence of DUI both in terms of proportions and numbers. A 50% reduction in incidence of DUI among cruiser drivers, holding other factors constant, would be expected to yield a reduction of 133 fatalities over the 11 years of crash records, or about 12 fewer deaths per year.

Column 6 of Table 25 reports the numbers of drivers in fatal and non-fatal crashes who were speeding at the time of the crash, and column 7 shows the associated percentages. Of 1,263 fatal crashes (shown in the first row of data), 536 of these drivers were speeding at the time of the crash, or 42%. This compares to 18% of drivers involved in all non-fatal crashes who were speeding. Although the number of speeding drivers involved in all non-fatal crashes (4,290) is eight times larger than the number of speeding drivers in all fatal crashes (536), the percent of speeding drivers in non-fatal crashes is much lower than the percent of speeding drivers in fatal crashes because of the much larger number of non-fatal (23,848) vs. fatal (1,263) crashes. This difference in the proportions of drivers who were speeding in fatal vs. non-fatal crashes (42% vs. 18%) explains why the Series 1 and 2 Models showed large effects of speeding on crash outcomes.

Column 7 of Table 25 also reveals that the proportions of speeding drivers in fatal crashes varied considerably across crash categories. Drivers in single vehicle fatal crashes were much more likely to be speeding than drivers in multiple vehicle fatal crashes (53% vs. 35%). Drivers in fatal sport bike crashes were much more likely to be speeding than drivers in fatal cruiser crashes (58% vs. 34%), and more likely to be speeding than unknown bike type drivers in fatal crashes (58% vs. 47%). Thus, speeding played an important role in fatalities for all types of motorcycle crashes, but the magnitude of influence varied considerably by crash category. A 50% reduction in incidence of speeding among all motorcycle drivers, holding other factors constant, would be expected to yield a reduction of 268 fatalities over the 11 years of crash records, or about 24 fewer deaths per year.

Column 8 of Table 25 reports the numbers of drivers in fatal and non-fatal crashes whose records showed an MBAC at some point in their driving careers, and column 9 shows the associated percentages. As can be seen in Figure 5, drivers with an MBAC were more likely to wear a helmet, less likely to be DUI, and less likely to be severely injured or killed in a crash. Conversely, drivers without an MBAC were less likely to wear a helmet, more likely to be DUI, and more likely to be severely injured or killed. Of 1,263 drivers in fatal crashes, 1,036 had an MBAC, or 82%. This compares to 90% of drivers involved in all non-fatal crashes who had an MBAC. Sport bike and unknown bike type drivers in fatal crashes were the least likely to have an MBAC (78% and 76%, respectively). Although it is beyond the scope of this study to determine why some motorcycle drivers failed to get an MBAC, it seems likely that if they could be persuaded to do so (which would require demonstration of the requisite knowledge and skills), then they would drive more safely and fewer of them would crash.

Table 26 addresses the roles of DUI, speeding, and MBAC in fatal and non-fatal crashes, along with the additional factor of helmet use. (Note that the total numbers of fatal and non-fatal crashes listed in Table 26 are somewhat lower than the corresponding values in Table 25 due to missing data – to be included in Table 26, cases must have complete data on crash outcome, DUI, speeding, MBAC, *and* helmet use.) The relevant comparisons in Table 26 to determine the joint effects of helmet use and DUI are shown in column 5, comparing percentages of fatal crashes with helmets to fatal crashes without helmets, and comparing percentages of non-fatal crashes with helmets to non-fatal crashes without helmets. A greater proportion of all fatal crashers without helmets were DUI (37%) than fatal crashers with helmets (29%). A greater proportion of all non-fatal crashers without helmets were DUI (6%) than non-fatal crashers with helmets (3%). The same patterns hold for other column 5 comparisons. Thus, as previously shown in the models tested, being DUI contributed to the choice not to wear a helmet while riding.

The relationships between speeding and helmet use are somewhat complex, according to the percentages shown in column 7. Among all fatal crashers, helmet use was unrelated to the likelihood of speeding (43% of both helmeted and non-helmeted fatal crashers were speeding). Likewise, among all non-fatal crashers helmet use was unrelated to speeding (19% of both helmeted and non-helmeted non-fatal crashers were speeding). There is some evidence that wearing a helmet was associated with a greater likelihood of speeding among sport bike crashers. In fatal crashes, a greater proportion of sport bike drivers wearing a helmet were speeding (61%) than sport bike drivers without a helmet (57% speeding). The same pattern holds for sport bike drivers in non-fatal crashes (with helmet, 26% speeding; without helmet, 23% speeding). The opposite patterns hold true for cruisers – wearing a helmet was associated with less likelihood of speeding, not wearing a helmet was associated with greater likelihood of speeding. It appears that sport bike drivers may regard the protection afforded by a helmet as providing a margin of safety that allows them to driver faster.

The relationships between having an MBAC on record and helmet use are straightforward, and consistent with findings of the models described above. The percentages of drivers with an MBAC were greater if the driver was wearing a helmet than if driver was not wearing a helmet. The only exception was among cruiser drivers in fatal crashes, where drivers without helmets were somewhat more likely to have an MBAC.

Contributing Factors to Crashes: Odds Ratios

Proportions of crashers who were DUI, speeding, or had an MBAC (see preceding section) provide insight into the magnitude of the problem – i.e., how many fewer fatalities might result from improvements in these factors. Another way to represent the complex relationships among factors implicated in motorcycle crashes is to express them in terms of odds ratios. An odds ratio can be interpreted at the level of an individual driver. What are the odds that a DUI driver in a crash will be killed? What are the odds that a speeding driver in a crash will be killed? What are the odds that a driver in a crash who is both DUI and speeding will be killed? Table 27 displays odds that answer these and similar questions.

Column 2 of Table 27 shows the odds for all crashes. For each row, comparisons are for the worst to best case scenarios. Thus, reading down column 2, for all crashes the odds of a fatality were: (a) 11 times greater if the driver was DUI at the time of the crash than if the driver was not DUI, (b) 3 times greater if the driver was speeding than not speeding, (c) 1.25 times greater if the driver was not wearing a helmet than wearing a helmet, (d) 2 times greater if the driver had no MBAC ever than if the driver had an MBAC, (e) 22 times greater if the driver was both DUI and speeding than if the driver was neither DUI nor speeding, (f) 15 times greater if the driver was DUI without an MBAC than if the driver was not DUI and had an MBAC, (g) 6 times greater if the driver was speeding without an MBAC than if the driver was not speeding and had an MBAC, and (h) 33 times greater if the driver was DUI and speeding without an MBAC than if the driver was not DUI, not speeding, and had an MBAC. The pattern of results indicates that each factor (DUI, speeding, and no MBAC) increases the odds of a fatality in a crash; these factors in combination greatly increase the odds of fatality.

Columns 3, 4, and 5 present corresponding odds for sport bike, cruiser, and unknown bike type crashes. The odds of a fatality if the driver was DUI varied somewhat according to motorcycle type, from a high of 13 to 1 for cruisers to a low of 9 to 1 for unknown bikes. The most striking variability of fatality odds across motorcycle types occurred for crashes in which the driver was DUI and speeding without an MBAC. A sport bike driver who crashed with these characteristics was 60 times more likely to die than a sport bike driver who exhibited none of them. This compares to cruiser and unknown bike type drivers, who were 29 times more likely to die in a crash if they exhibited these characteristics than if they did not.

The models described earlier reveal that choices made proximal to a crash are influenced by concurrent and antecedent choices and behaviors. These influences can also be expressed as odds ratios. Some of these are shown in Table 27. The odds of being DUI at the time of the crash were 8 times greater for drivers with 1 or more DUI violations on record. These odds varied from a high of 13 to 1 for unknown bike type drivers, to a low of 6 to 1 for cruiser drivers. Drivers with a history of drinking and driving should be especially careful to avoid this when riding a motorcycle. Males were 4 times more likely to be DUI in a crash than females, considering all crashes. The odds of DUI were

Table 27. Odds Ratios by Major Crash Categories

	All Crashes	Sport Bike Crashes	Cruiser Crashes	Unknown Bike Type Crashes
Odds of Fatality if:				
DUI	11 :: 1	10 :: 1	13 :: 1	9 :: 1
Speeding	3 :: 1	4 :: 1	3 :: 1	3 :: 1
No Helmet	1.25 :: 1	1.25 :: 1	1.25 :: 1	1.25 :: 1
No MBAC	2 :: 1	2 :: 1	2 :: 1	2 :: 1
DUI & Speeding	22 :: 1	23 :: 1	23 :: 1	19 :: 1
DUI & No MBAC	15 :: 1	18 :: 1	17 :: 1	12 :: 1
Speeding & No MBAC	6 :: 1	8 :: 1	6 :: 1	5 :: 1
DUI, Speeding, & No MBAC	33 :: 1	60 :: 1	29 :: 1	29 :: 1
Odds of DUI if:				
1 or More DUI Violations	8 :: 1	10 :: 1	6 :: 1	13 :: 1
Gender (Male)	4 :: 1	2 :: 1	5 :: 1	3 :: 1
Odds of Speeding if:				
DUI	3 :: 1	3 :: 1	3 :: 1	3 :: 1
2 or More Speeding Violations	1.5 :: 1	1.5 :: 1	1.5 :: 1	1.5 :: 1
Driver Age (< 30)	2 :: 1	1.5 :: 1	1.5 :: 1	2 :: 1
Odds of No Helmet if:				
DUI	2 :: 1	1.5 :: 1	1.75 :: 1	2 :: 1
No MBAC Ever	3 :: 1	3 :: 1	1.75 :: 1	4 :: 1
Driver Age (30+)	1.25 :: 1	1.5 :: 1	1.25 :: 1	1 :: 1
Odds of No MBAC Ever if:				
Gender (Male)	1.25 :: 1	3 :: 1	1.25 :: 1	1.5 :: 1
Driver Age (Younger)	3 :: 1	1.25 :: 1	3 :: 1	2 :: 1
Odds of DUI if (post-PAMSP Sample):				
1 or More DUI Violations	11 :: 1	18 :: 1	5 :: 1	28 :: 1
No PAMSP Pass	4 :: 1	5 :: 1	5 :: 1	9 :: 1
PAMSP Pass & 1 or More DUI	1.25 :: 1	NS	2 :: 1	NS
No PAMSP Pass & 1 or More DUI	27 :: 1	38 :: 1	15 :: 1	83 :: 1

Note. Odds compare worst to best case scenarios: DUI to not DUI, speeding to not speeding, etc. Thus, the likelihood of death for a DUI driver in a crash is 11 times greater than the likelihood of death for a non-DUI driver in a crash. For combinations, the comparison is to the opposite for each variable in the combination; for example, crashes in which the driver is DUI and speeding without an MBAC are compared to crashes in which the driver is not DUI, not speeding, with an MBAC. Odds shown between 1 and 2 are rounded to the nearest .25 percent; odds of 2::1 or greater are rounded to the nearest whole number. NS indicates that odds could not be calculated due to an insufficient number of "PAMSP Pass & 1 or More DUI" cases that were DUI at time of crash.

greatest for males in cruiser crashes (5 times greater than females), and lowest for sport bike crashes (2 times greater than females). The odds of speeding at the time of the crash were 3 times greater if the driver was also DUI at the time of the crash, and 1.5 times greater if the driver had 2 or more speeding violations on record. These odds did not vary by type of motorcycle. The odds of speeding were somewhat greater for younger drivers (under age 30). Younger drivers were twice as likely to speed as older drivers in all crashes, with these odds varying only slightly by type of motorcycle.

The odds of not wearing a helmet were 2 times greater if the driver was DUI. These odds also varied only slightly by type of motorcycle. The odds of not wearing a helmet were 3 times greater for drivers who had no record of an MBAC; these odds varied somewhat by type of motorcycle. Older drivers were slightly less likely to wear a helmet (1.25::1), with only slight variability across types of motorcycles.

The odds of no MBAC were slightly greater for males (1.25::1), especially for males driving sport bikes (3::1), and for younger drivers (3::1). Younger male drivers in crashes were the least likely to have an MBAC.

The last set of odds ratios shown in Table 27 were calculated for drivers with an initial MBAC date of April 2004 or later, corresponding to the period for which we were provided PAMSP records. Models tested for this sample (see, for example, Figures 57 and 58, Appendix G) showed significant positive paths from Number of DUIs on record to DUI at crash, indicating that past DUI violations increase the likelihood of DUI at time of crash. These models also revealed significant negative paths from PAMSP Pass to DUI at crash, indicating that passing a PAMSP course decreases the likelihood of DUI at time of crash. These countervailing forces were examined further through odds ratios.

For the post-PAMSP sample, the odds of DUI at crash were 11 times greater if a driver had one or more DUI violations on record. The odds of DUI at crash were 4 times greater for drivers who did not take or pass a PAMSP course than for drivers who passed a course. For drivers who passed a PAMSP course *and* had one or more DUI violations on record, the odds of DUI at crash were only slightly greater than chance (1.25::1, compared to drivers who did not take or pass a PAMSP course and who had no DUI violations on record). For drivers who did *not* take or pass a PAMSP course *and* had one or more DUI violations on record, the odds of DUI at crash were 27 times greater than for drivers who passed a PAMSP course and had no DUI violations on record. Thus, passing a PAMSP course appears to effectively counteract the tendency to drink and ride. The magnitude of this effect varies across motorcycle types, being most prominent among unknown bike type drivers.

Odds ratios express the relationships among crash factors and outcomes in a way that personalizes a driver's choices and their consequences. A motorcycle driver can substantially reduce his or her chances of severe injury and death in a crash by choices made before and during the ride. Information about odds can be used to educate drivers and help them to make better and smarter riding choices.

A Word about Proportions and Odds Ratios

Calculating proportions and odds ratios such as those shown in Tables 25, 26, and 27 require dichotomous variables (i.e., having yes-no or 0-1 values). Proportions and odds ratios are alternative ways to express the findings of the Series 1 and 2 models pertaining to motorcycle driver fatalities. Because the overall proportion of fatalities in crashes is approximately 5%, the numbers of fatalities for many of the breakdowns shown in these tables are necessarily small relative to the numbers of crashes for those breakdowns. The proportions, odds, and indeed the findings of the models explaining crash fatalities are based on the total numbers of crashes for each breakdown category, not just the numbers of fatalities. It must also be noted that for each of the Series 1 and 2 models explaining fatalities, a parallel model explaining injury severity was also tested. Findings of the injury severity models cannot be expressed as proportions or odds because injury severity is a continuous variable; however, findings of the injury severity models are very similar to the findings of the fatality models and are based on the same large samples. In our opinion, the findings and conclusions of these various approaches to the analyses are robust due to the large samples upon which they are based.

Effects of BRC and ERC Training

To further assess the effects of training, two sets of comparisons were made of crashes: (1) crashes by drivers who had passed the BRC vs. crashes by drivers who did not pass the BRC but had an MBAC, and (2) crashes by drivers who passed the BRC (but who did not take or pass the ERC) vs. crashes by drivers who passed the ERC. Comparisons were made on previous driving records, crash and driver characteristics, driver actions contributing to the crash, and outcomes of the crash. Results of t-tests comparing these groups are shown in Table 28. Non-significant differences between groups are designated in the "Sig." columns by NS.

Drivers with BRC Pass vs. Drivers Who Did Not Take or Pass the BRC

For this set of comparisons, we used data from (a) crashers who passed the BRC and (b) crashers who had an MBAC code after 2004 (the start of the PAMSP records) and who did not pass the BRC.

Driving Records

At the time of crash, the driving records of BRC passers were significantly different from those who had not taken (or, in a few cases, taken but not passed) the BRC. As shown in Table 28, BRC passers had fewer suspensions, fewer speeding violations, fewer previous accidents, fewer total violations, fewer sanctions, and so on, than crashers who did not pass the BRC. All in all, crashers who passed the BRC had much cleaner driving records than crashers who did not take or pass the BRC.

Crash/Driver Characteristics

Passing the BRC was not related to an increased probability of a crash being single- or multi-vehicle, or to number of units or people involved in the crash. Individuals ***not*** passing the BRC and crashing were more likely to: not wear a helmet, be DUI, be younger and male, crash at night, crash in a rural area, crash off (vs. on) the roadway, hit a fixed object, have a mid-block crash (not at an intersection or off/on ramp), and crash with no adverse environmental conditions present.

Driver Actions
Drivers who passed the BRC were much less likely to be speeding, deemed inexperienced, at fault (i.e., coded as unit one), or driving improperly than their non-BRC pass counterparts. BRC passers and non-passers were equally likely to over- or under-compensate at a curve.

Crash Outcomes
Driver without a BRC pass had a lower level of average crash injury severity, but the number of fatalities, odds of a fatality to anyone involved in the crash, and number of persons injured were not different for BRC vs. no BRC crashers.

In summary, it is clear that the two groups of crashers (BRC vs. no BRC) have significantly different driving histories. BRC passers are safer drivers generally, according to driving records. This “safety consciousness” is likely to lead them to take the BRC in the first place, and at the same time lead them to wear a helmet, drive more cautiously, etc. This a priori difference suggests caution when drawing inferences about the benefits of training because we do not definitively know if observed effects are due to training or to pre-existing differences between trained vs. untrained groups. Our sense of this, based on the data and upon training observations, is that both are probably true: training is effective for those who take it, and those who don’t are probably less safety conscious and less likely to seek opportunities to learn about motorcycle safety.

Table 28. Comparisons of Drivers Who Passed BRC to Drivers Who Did Not Pass BRC

	BRC vs No BRC					BRC vs ERC				
	Driving Records of Motorcycle Crashers: BRC Passers vs. No BRC Pass (filtered for post MSP date)					Driving Records of Motorcycle Crashers: BRC Passers vs ERC Passers				
	BRC Pass	*N*	*Mean*	*t-test*	*Sig.*	*Pass BRC / ERC*	*N*	*Mean*	*t-test*	*Sig.*
Number of Suspensions	No BRC Pass BRC	2480 1099	2.63 1.40	5.59	0.000	BRC ERC	2020 308	1.55 1.44	0.37	NS
Number of Sanctions	No BRC Pass BRC	2480 1099	2.86 1.56	5.80	0.000	BRC ERC	2020 308	1.75 1.64	0.35	NS
Number of Driving Violations	No BRC Pass BRC	2480 1099	2.58 1.78	6.15	0.000	BRC ERC	2020 308	2.11 2.03	0.37	NS
Number of License Restrictions	No BRC Pass BRC	2480 1099	0.42 0.16	5.79	0.000	BRC ERC	2020 308	0.22 0.18	0.63	NS
Number of Failures to Stop/Yield	No BRC Pass BRC	2480 1099	0.32 0.27	1.91	NS	BRC ERC	2020 308	0.30 0.32	-0.48	NS
Number of Speeding Violations	No BRC Pass BRC	2480 1099	1.13 0.90	3.54	0.000	BRC ERC	2020 308	1.07 1.10	-0.24	NS
Number of Improper Driving Violations	No BRC Pass BRC	2480 1099	0.44 0.28	5.15	0.000	BRC ERC	2020 308	0.33 0.27	1.21	NS
Number of DUI	No BRC Pass BRC	2480 1099	0.27 0.17	3.43	0.001	BRC ERC	2020 308	0.19 0.16	0.67	NS
Previous 15 Day Suspension Count	No BRC Pass BRC	2480 1099	0.30 0.11	5.70	0.000	BRC ERC	2020 308	0.16 0.10	1.35	NS
Previous DUI Count	No BRC Pass BRC	2480 1099	0.04 0.02	1.55	NS	BRC ERC	2020 308	0.04 0.04	0.47	NS
Previous Harmful Conviction Count	No BRC Pass BRC	2480 1099	0.69 0.34	6.45	0.000	BRC ERC	2020 308	0.39 0.22	2.50	0.012
Previous Violation Count	No BRC Pass BRC	2480 1099	0.60 0.29	6.38	0.000	BRC ERC	2020 308	0.57 0.89	-3.48	0.001
Previous Speeding Count	No BRC Pass BRC	2480 1099	0.28 0.14	5.35	0.000	BRC ERC	2020 308	0.29 0.54	-4.77	0.000
Previous Suspension Count	No BRC Pass BRC	2480 1099	0.59 0.20	4.02	0.000	BRC ERC	2020 308	0.43 0.52	-0.55	NS
Number of Failure to Respond	No BRC Pass BRC	1717 756	2.04 1.19	3.50	0.000	BRC ERC	1407 218	1.19 1.18	0.03	NS
Number of Other Violations	No BRC Pass BRC	1717 756	0.19 0.10	3.66	0.000	BRC ERC	1407 218	0.13 0.18	-1.44	NS
Number of Non-Highway Safety Violations	No BRC Pass BRC	1717 756	0.21 0.11	3.71	0.000	BRC ERC	1407 218	0.13 0.06	1.67	NS
Number of Accidents	No BRC Pass BRC	1717 756	1.78 1.67	2.47	0.013	BRC ERC	1407 218	1.82 1.99	-2.12	0.034
Number of 6-point Exams	No BRC Pass BRC	1717 756	0.34 0.23	4.65	0.000	BRC ERC	1407 218	0.28 0.28	-0.02	NS
Number of Hearings	No BRC Pass BRC	1717 756	0.26 0.13	4.47	0.000	BRC ERC	1407 218	0.18 0.14	0.93	NS
Total Violations and Sanctions	No BRC Pass BRC	1717 756	11.00 6.68	6.38	0.000	BRC ERC	1407 218	7.54 7.13	0.42	NS
Total Number of Violations	No BRC Pass BRC	1717 756	6.25 4.04	6.26	0.000	BRC ERC	1407 218	4.54 4.36	0.36	NS
Total Number of Motorcycle Crashes (including current)	No BRC Pass BRC	2480 1099	1.10 1.11	-0.51	NS	BRC ERC	2020 308	1.12 1.20	-3.24	0.001

Table 28. Comparisons of Drivers Who Passed BRC to Drivers Who Did Not Pass BRC (cont'd)

	BRC vs No BRC					BRC vs ERC				
	Crash/Driver Characteristics: BRC Passers vs. No BRC Pass					Crash/Driver Characteristics: BRC Passers vs. No BRC Pass				
	BRC Pass	*N*	*Mean*	*t-test*	*Sig.*	*Pass BRC / ERC*	*N*	*Mean*	*t-test*	*Sig.*
Single or Multiple Vehicle Crash (1 = single, 2 = multiple)	No BRC	2480	1.49	-1.42	NS	BRC	2020	1.53	-0.92	NS
	Pass BRC	1099	1.52			ERC	308	1.56		
Any Adverse Environmental Condition (0 = no, 1 = yes)	No BRC	2444	0.14	-1.98	0.048	BRC	1999	0.16	-0.43	NS
	Pass BRC	1084	0.17			ERC	308	0.17		
Urban or Rural (1 = rural, 2 = urban)	No BRC	2435	1.66	-1.99	0.047	BRC	1922	1.68	1.99	0.047
	Pass BRC	1092	1.69			ERC	286	1.63		
Unit Number	No BRC	2480	1.26	-3.05	0.002	BRC	2020	1.33	-1.22	NS
	Pass BRC	1099	1.31			ERC	308	1.37		
Total Units Involved in Crash	No BRC	2480	1.54	-0.80	NS	BRC	2020	1.59	-1.20	NS
	Pass BRC	1099	1.56			ERC	308	1.63		
Number of People Involved in Crash	No BRC	2480	1.79	-0.56	NS	BRC	2020	1.88	-0.65	NS
	Pass BRC	1099	1.81			ERC	308	1.93		
Driver Helmet (1 = no, 2 = yes)	No BRC	1408	1.81	-2.56	0.011	BRC	1007	1.84	-0.36	NS
	Pass BRC	666	1.86			ERC	115	1.85		
Age at Crash	No BRC	2476	30.08	-9.97	0.000	BRC	2018	34.67	-10.66	0.000
	Pass BRC	1099	34.43			ERC	308	42.69		
DUI (coded for all crashers, 0 = no, 1 = yes)	No BRC	2480	0.04	4.65	0.000	BRC	2020	0.02	0.09	NS
	Pass BRC	1099	0.01			ERC	308	0.02		
Alcohol Test Result (for those tested, value*100)	No BRC	203	7.89	3.30	0.001	BRC	111	6.65	0.08	NS
	Pass BRC	55	3.42			ERC	15	6.47		
Driver Gender (1 = female, 2 = male)	No BRC	2478	1.95	8.03	0.000	BRC	2018	1.90	-1.40	NS
	Pass BRC	1098	1.88			ERC	308	1.92		
Engine Size (in cubic centimeters)	No BRC	1563	779.99	-4.10	0.000	BRC	1258	877.44	-7.15	0.000
	Pass BRC	719	843.95			ERC	208	1074.28		
Passenger (1 = no, 2 = yes)	No BRC	2369	1.07	-0.17	NS	BRC	1873	1.09	-1.12	NS
	Pass BRC	1060	1.08			ERC	279	1.11		
Motorcycle Model Year	No BRC	2225	2000.22	-4.29	0.000	BRC	1862	1999.90	2.32	0.020
	Pass BRC	1018	2001.32			ERC	286	1998.86		
Intersection Type (recoded, 0 = midblock, 1 = else)	No BRC	2480	0.35	-3.37	0.001	BRC	2020	0.39	-0.41	NS
	Pass BRC	1099	0.41			ERC	308	0.41		
Illumination (recoded, 0 = daylight, 1 = else)	No BRC	2480	0.28	3.18	0.001	BRC	2020	0.24	0.50	NS
	Pass BRC	1099	0.23			ERC	308	0.22		
Crash Relative to Roadway (recoded, 0=on roadway, 1 = else)	No BRC	2476	0.30	3.05	0.002	BRC	2012	0.24	0.89	NS
	Pass BRC	1095	0.25			ERC	308	0.22		
Collision (recoded, 0 = noncollision, 1 = collision)	No BRC	2480	0.70	0.48	NS	BRC	2020	0.71	-0.70	NS
	Pass BRC	1099	0.70			ERC	308	0.73		
Rear-end Collision (recoded, 0 = else, 1 = rear-end)	No BRC	2480	0.11	-1.16	NS	BRC	2020	0.13	-0.20	NS
	Pass BRC	1099	0.12			ERC	308	0.13		
Angle Collision (recoded, 0 = else, 1 = angle collision)	No BRC	2480	0.21	-0.31	NS	BRC	2020	0.23	-1.35	NS
	Pass BRC	1099	0.22			ERC	308	0.27		
Hit Fixed Object Collision (recoded, 0 = else, 1 = hit fixed object)	No BRC	2480	0.22	2.25	0.024	BRC	2020	0.18	0.71	NS
	Pass BRC	1099	0.19			ERC	308	0.17		
1st Roadway-environment (recoded, 0 = nothing, 1 = else)	No BRC	2429	0.13	-2.01	0.045	BRC	1991	0.15	-0.38	NS
	Pass BRC	1079	0.16			ERC	305	0.16		

Table 28. Comparisons of Drivers Who Passed BRC to Drivers Who Did Not Pass BRC (cont'd)

	BRC vs No BRC					BRC vs ERC				
	Driver Actions					Driver Actions				
	BRC Pass	***N***	***Mean***	***t-test***	***Sig.***	***Pass BRC / ERC***	***N***	***Mean***	***t-test***	***Sig.***
Motorcycle Driver More at Fault (unit 1, 0 = no, 1 = yes)	No BRC	2480	0.75	2.77	0.006	BRC	2020	0.69	1.16	NS
	Pass BRC	1099	0.71			ERC	308	0.66		
Driver Action Speeding (0 = no, 1 = yes)	No BRC	2480	0.26	5.01	0.000	BRC	2020	0.19	0.23	NS
	Pass BRC	1099	0.19			ERC	308	0.19		
Driver Action Under or Overcompensation at Curve (0 = no, 1 = yes)	No BRC	2480	0.11	0.35	NS	BRC	2020	0.10	1.90	NS
	Pass BRC	1099	0.11			ERC	308	0.06		
Driver Action Inexperienced (0 = no, 1 = yes)	No BRC	2480	0.20	4.46	0.000	BRC	2020	0.11	3.37	0.001
	Pass BRC	1099	0.14			ERC	308	0.05		
Driver Action Affected by Physical Condition (0 = no, 1 = yes)	No BRC	2480	0.04	2.48	0.013	BRC	2020	0.03	-0.57	NS
	Pass BRC	1099	0.02			ERC	308	0.04		
Driver Action Improper Driving (0 = no, 1 = yes)	No BRC	2480	0.20	-0.04	NS	BRC	2020	0.21	0.16	NS
	Pass BRC	1099	0.20			ERC	308	0.21		
Driver Action Other Improper Driving (0 = no, 1 = yes)	No BRC	2480	0.11	2.88	0.004	BRC	2020	0.08	-0.68	NS
	Pass BRC	1099	0.08			ERC	308	0.09		

	BRC vs No BRC					BRC vs ERC				
	Outcomes					Outcomes				
	BRC Pass	***N***	***Mean***	***t-test***	***Sig.***	***Pass BRC / ERC***	***N***	***Mean***	***t-test***	***Sig.***
Anyone Killed (0 = no, 1 = yes)	No BRC	2480	0.05	1.20	NS	BRC	2020	0.03	1.18	NS
	Pass BRC	1099	0.04			ERC	308	0.02		
Motorcycle Driver Killed (0 = no, 1 = yes)	No BRC	2160	0.05	0.80	NS	BRC	1718	0.03	1.37	NS
	Pass BRC	898	0.04			ERC	263	0.02		
Motorcycle Driver Injury Severity (recoded, 1 = not injured, 2 = minor injury, 3 = moderate injury, 4 = major injury, 5 = killed)	No BRC	2160	3.27	-3.83	0.000	BRC	1718	3.42	-2.39	0.017
	Pass BRC	898	3.41			ERC	263	3.56		
Number of Fatalities	No BRC	2480	0.048	1.31	NS	BRC	2020	0.03	1.20	NS
	Pass BRC	1099	0.037			ERC	308	0.02		
Number of Persons Injured	No BRC	2480	1.04	0.62	NS	BRC	2020	1.06	-1.49	NS
	Pass BRC	1099	1.03			ERC	308	1.11		

Note. NS indicates that the difference between group means is not significant.

Drivers with BRC Pass vs. Drivers with ERC Pass

For this set of comparisons, we compared those who passed the BRC (but not ERC) to those who passed the ERC.

Driving Records and Crash/Driver Characteristics
Generally speaking, the driving records of the BRC and ERC passers are highly similar, though there are a few notable differences. ERC crashers were significantly older (43 years), on average, than their BRC counterparts (35 years). The greater age of ERC crashers may be also a proxy for increased experience and increased exposure, which may explain the increased previous speeding count of ERC crashers. In the few other significant differences which were detected in our analyses, the ERC drivers were otherwise slightly safer than their BRC counterparts.

ERC crashes were slightly more likely to occur in rural areas and riding motorcycles with bigger engines, but ERC crashers were ***not*** less likely to: be DUI, involved in single vehicle crashes, crash in adverse environmental conditions, or have a passenger. Also, the location (intersection, relative to roadway) and type of crashes (rear end, angle, hit fixed object) were not different for the two groups.

Driver Actions
Examining driver actions implicated in the crash, ERC and BRC crashers did not differ on improper driving or speeding, but ERC crashers were less likely to be deemed inexperienced and to have under- or over-compensated at a curve.

Crash Outcomes
ERC crashers had a higher average level of injury severity, but fatalities and number of persons injured were not different when comparing ERC to BRC passers.

Taken together, there is minimal evidence of significant differences between BRC vs. ERC drivers who were involved in a crash. ERC crashers were older and more experienced than their BRC counterparts and had a slightly higher level of injury severity, but on the whole, these two groups of drivers and their crashes are relatively similar.

Odds Ratios for PAMSP Pass Comparisons

As described above with respect to factors implicated in all motorcycle crashes, relationships between passing vs. not passing a PAMSP course and crash factors can be expressed as odds ratios. Odds ratios, calculated on 3,579 motorcycle drivers with an initial MBAC date during the "PAMSP era" (between April 2004 and December 2007) who crashed, are shown in Table 29.

Column 2 of Table 29 shows the odds for all PAMSP-era crashes. Reading down column 2, compared to drivers who passed a PAMSP course, if the driver did not take or pass a PAMSP course the odds: (a) of a fatality were 1.25 times greater, (b) of speeding were

1.5 times greater, (c) were equal if the driver over- or under-compensated at a curve, (d) were equal if the driver committed an improper driving violation, (e) were 1.5 times greater if the driver committed an other improver driving violation, (g) were1.5 times greater if the driver was inexperienced, (h) were 4 times greater if the driver was DUI, and (i) were equal if the driver wore a helmet. Columns 3, 4, and 5 present corresponding odds for sport bike, cruiser, and unknown bike type crashes.

Note that most odds ratios shown in Table 29 were small, and that not all were statistically significant. In some cases, the odds shown are negative (i.e., below 1::1), indicating that the relationships are opposite to others in the same row. These findings are expressed as positive odds in the lower portion of Table 29. Thus, if a driver passed a PAMSP course the odds of fatality in a crash were higher (2::1) for unknown bike types, and the odds of wearing a helmet were greater for cruiser and unknown bike type drivers but not for sport bike drivers.

Table 29. Odds Ratios for PAMSP Pass Comparisons

	All Crashes	Sport Bike Crashes	Cruiser Crashes	Unknown Bike Type Crashes
If No PAMSP Course Taken or Passed, Odds of:				
Driver Fatality	1.25 :: 1	2 :: 1*	1.25 :: 1	0.50 :: 1*
Speeding	1.5 :: 1*	1.25 :: 1	1.25 :: 1*	1.75 :: 1*
Over/Under Compensation at Curve	1 :: 1	1.25 :: 1	1 :: 1	1 :: 1
Improper Driving	1 :: 1	0.75 :: 1	1 :: 1	1 :: 1
Other Improper Driving	1.5 :: 1*	1.25 :: 1	1.75 :: 1*	1.5 :: 1*
Inexperience	1.5 :: 1*	2 :: 1*	1.5 :: 1*	1.5 :: 1*
DUI	4 :: 1*	5 :: 1*	5 :: 1*	9 :: 1*
Helmet Use	1 :: 1	1.25 :: 1	0.75 :: 1*	0.75 :: 1*
If PAMSP Course Passed, Odds of:				
Driver Fatality	0.75 :: 1	0.50 :: 1*	0.75 :: 1	2 :: 1*
Improper Driving	1 :: 1	1.25 :: 1	0.75 :: 1*	1 :: 1
Helmet Use	1 :: 1	0.75 :: 1	1.25 :: 1*	1.25 :: 1*

Note. Odds ratios are calculated on 3,579 motorcycle drivers with an initial MBAC date between April 2004 and December 2007 who crashed. Odds compare drivers who passed an MPS course to drivers who did not take or did not pass a PAMSP course. Thus, the likelihood of death for a driver in a crash who did not take or pass a PAMSP course is 1.25 times greater than the likelihood of death for a driver in a crash who passed a PAMSP course. Odds less than 1 (e.g., 0.50::1) indicate an inverse relationship. Odds of driver fatality were *greater* if no PAMSP course was taken or passed for all crashes, sport bike, and cruiser crashes, but fatality odds for unknown bike type crashes were *less* if no MPS course was taken or passed. Corresponding direct odds are shown in the second section of the table, where odds of a driver fatality for unknown bike types are 2::1 for drivers who passed a PAMSP course. Odds shown between 1 and 2 are rounded to the nearest .25 percent; odds of 2::1 or greater are rounded to the nearest whole number. Statistically significant odds (i.e., greater than chance odds of 1::1) are noted by *.

Task 3: Strategy Development

As shown in Figure 1, a series of meetings were held throughout the project among the researchers, the project Technical Advisor, and (as appropriate) key stakeholders who are responsible for administering the PAMSP. These individuals possess a wealth of knowledge, information, and insight concerning operation of the PAMSP. By virtue of their "front line" observations and experience, they understand PennDOT's current practices, including variations in their applications, their effectiveness, and ideas for improvements.

PAMSP Course Observations

Researchers attended BRC and ERC classes, in several locations, as observers. At one BRC, a researcher participated in the class as a student. These observations provided us with first-hand experience of instructional methods, course content, and student reactions to these courses, as well as variability in training practices across locations. The following chart shows locations and dates of observations.

Course	Date	Portion	Location	Observer(s)
BRC	7/20/2007	Classroom	State College, PA	Hood, Hoskins, Vance
	7/21/2007	Field		
	7/27/2007	Classroom		
	7/28/2007	Field		
BRC	8/17/2007	Classroom	State College, PA	Renz (student & observer)
	8/18/2007	Field		
	8/24/2007	Classroom		
	8/25/2007	Field		
BRC	9/24/2007	Classroom	Williamsport, PA	Hood
	9/25/2007	Field		
	9/27/2007	Classroom		
ERC	9/30/2007	Field	Philadelphia, PA	Hood, Hoskins
ERC	10/6/2007	Field	Portage, PA	Hood, Vance
BRC	10/18/2007	Classroom	Oakdale, PA	Hood
	10/21/2007	Field	Oakdale, PA	Hood

The BRC course consists of 5.5 hours of classroom training and 10 hours of skills training in a large parking lot. The ERC course consists of 6 hours of skills training. Students must have a valid Pennsylvania Class M license or permit to register for a course. Motorcycles and helmets are provided for students attending the BRC; students attending the ERC provide their own motorcycles and helmets. Classroom training focused on the concepts of risk, types of motorcycles, preparing to ride a motorcycle (personal protective gear, pre-trip inspections, maintenance, basic skills discussions), and street strategies (positioning, visibility, situations, etc.). In the classroom, and more significantly in the field, the following skills were emphasized:

1. Basic motorcycle features
2. Control at low speed
3. Gearing
4. Maneuverability
5. Stopping quickly
6. Control in limited space areas
7. Negotiating a curve
8. Cornering judgment and technique
9. Cornering 'finesse' – long curves
10. Stopping quickly on a curve
11. Hazard avoidance
12. Compound curves – different radii

Whether operating a car, truck, or motorcycle, there are three distinct phases to the driving task: information, decision, and action. Roadway information leads the driver to decide to take an action. The results of that action provide more information, which then starts the process over again. Complicating the task of driving are motor skills necessary to operate the vehicle, distractions for the driver such as weather conditions, etc. In addition, many motor skills for operating a motorcycle are different than those for operating a car. Therefore, it takes skill and experience to make safe driving decisions on a motorcycle.

Skills in all three phases of the driving task were addressed in the observed ERC and BRC courses, with the focus on improving skill performance. Instructors often asked leading questions to participants who were struggling: Were they having difficulty getting information to perform a maneuver, deciding when and what to do, or physically performing the task? Emphasis was placed on practicing the skill maneuvers until competency.

The courses were systematic in that they follow a logical order from providing information on the very basics of the different types of motorcycles, locations of controls, how to start the engine, walking a motorcycle in neutral, and progressing through stopping quickly, avoiding hazards, negotiating curves, and controlling in limited spaces. They were also iterative in that for each skill and goal, instructors stated the objective of the exercise or module, explained it to the students, demonstrated it twice themselves, had the students participate and practice, and followed up with each student after performance so that they could adjust and improve skills. Skills practice was repeated until competency was obtained. Therefore, the training courses appeared to increase knowledge, influence attitudes about safety, and improve motor skills necessary to operate a motorcycle. Repetition of specific goals at the end of each exercise was observed so participants have a better understanding of the skill.

Researchers observed that both the BRC and ERC curricula accommodate three basic learning styles: visual, auditory, and kinesthetic. The courses and instructors accomplished this through the use videos and demonstrations (visual); lecture, group discussion, stories, questions/answers (auditory); and activities and outdoor exercises (kinesthetic). This well-rounded approach leads to maximum comprehension and retention.

The courses are also clearly designed for the adult learner as the basic adult learning principles were addressed in each course as described below. The field of adult learning was pioneered by Dr. Malcolm Knowles who identified the following characteristics of adult learners:

- Adults are *self-directed* and they need to take *responsibility*. In each of the BRC and ERC courses, instructors referred to themselves as facilitators and coaches who assist participants in obtaining the basic motorcycle skills *themselves* through encouragement: coaching rather than pure instruction and fact transfer. Whether it be to operate a motorcycle safely, avoid injury and death, or even just to obtain a license, adult participants are responsible for achieving these goals through the training. Instructors helped to facilitate that process.
- Adults have, over time, accumulated a wealth and variety of *life experiences* and *knowledge.* Researchers observed the BRC and ERC instructors drawing out participants' experience and knowledge relevant to the topic or skill being practiced. For beginner drivers, they interspersed lectures and field exercises with their own real-life experiences so that participants could relate. They also invited experienced drivers in the class to share their experiences.
- Adults are *goal-oriented*. Upon enrolling in a motorcycle safety course, adults usually know what goal they want to attain whether it be to learn to operate a motorcycle safely, to brush up on basic skills, to learn a new technique, to avoid injury and death, or even just to obtain a license. The ERC and BRC focused their classroom modules and field exercises and so that the participants could achieve those goals. The instructors facilitated the process and emphasized specific goals throughout the class, then they explained each module, the goal of each module, skill to be obtained, and why that skill is important. Participants then practiced each skill to proficiency. While these goals may not have been initially self-evident to new drivers (the goal might not mean much if they haven't ridden before), instructors did a good job of reviewing the goal at the end of the skill practice so that participants could relate the skill to a real life scenario
- Adults are *relevancy-oriented.* They want to know *why* they should learn, and researchers observed that instructors facilitated this concept by communicating the reasoning behind training tasks and modules. The BRC and ERC courses themselves addressed this concept by emphasizing the safety aspects of operating motorcycles properly throughout the classroom and field portions. For each

module, explanations were provided as to the relevancy from a safety and from a licensing standpoint.

- Adults are *practical*, focusing on the aspects of a lesson most useful to them; they may not be interested in knowledge for its own sake. The observed BRC and ERC courses used facts to emphasize certain safety or operational points rather than facts for knowledge alone. In addition, they focused more on why a skill will allow a driver to operate a motorcycle more safely and efficiently. A good example observed in the classroom was the emphasis placed on the technique to keep one's head up and looking through a turn rather than directly in front of the motorcycle. Another was one participant's comment that practicing everything on the skills evaluation immediately before taking the test was very helpful for skill review but also for reducing the nervousness of being evaluated.
- As do all learners, adults need to be shown *respect*. All observed instructors acknowledged the wealth of experiences that adult participants brought to the classroom. Participants were treated as equals and allowed to voice their opinions freely in class, especially in the ERC. Instructors were quick to point out any unsafe practices in the discussions.

In summary, adult participants in training want:

- a chance to tailor knowledge to their own needs,
- an opportunity to interact with others during the training session,
- to understand why something is important, and
- training that will demonstrate the benefits of learning.

The current BRC and ERC courses appeared to satisfy these principles in that they were learner-centered, encouraged a great deal of interaction, and emphasized practice to obtain necessary skills. The exercises in the outdoor portion of the training focused on a goal, an acquisition of a specific skill, and practice and testing of that skill in order to achieve successful completion. Instructors served as mentors in this process allowing people to learn at their own pace, recognize any problems and self-correct with minor prompting.

The observed courses were remarkably consistent across the state. At the same time, instructors were able to adjust their training a bit during discussions of typical scenarios and key required skills for their geographic setting. For example, in the course in Philadelphia, more time was invested in driving techniques in urban areas and at signalized intersections, while in Portage, more time was invested in driving techniques for rural settings.

Informal interviews with participants in each of the training sessions indicated high satisfaction with curriculum delivery as implemented by instructors. They indicated (and it was observed) that instructors implemented instructional strategies that utilize adult learning principles. Observations indicated that instructors:

- had good rapport with students,
- utilized hands-on demonstration and practice activities whenever possible in the field,

- utilized appropriate videos as needed in the classroom,
- varied delivery strategies to include a variety of learning preferences, and
- actively guided students to engage with each other and the content in both the classroom and the field.

From an instructional technique standpoint, as discussed above, instructors were more facilitators than traditional lecturers. They allowed participants to interact and learn from their own mistakes. They built confidence in the participants as evidenced by numerous comments to researchers. Participants were able to self-correct basic errors through practice, and instructors did not stop exercises in the middle or provide significant negative feedback unless injury could have resulted. Therefore, errors were allowed at the basic/safest levels, and adults learned to self-correct through reminders and limited guidance. Instructors also consistently provided positive feedback to encourage and reinforce developing skills.

Researchers generally remarked that classrooms were well-equipped and arranged to facilitate interaction. All students were reported to have the necessary materials for instruction. All instructors had adequate knowledge of the material, good experience (so that they were able to share 'experienced' tips with new drivers), and had a fluid delivery. The instructors actively encouraged interaction right from the start by asking attendees about situations that prompted them to enroll in the course (answers ranged from meeting other drivers to getting licensed to improving their skills). Goals for sessions were adequately communicated, learning was guided, and quizzes and skill checks were used appropriately. Students were generally observed to be engaged and participating in the training: they participated and were involved, were attentive and asked questions, shared personal experiences, and followed in the book where appropriate.

There were two primary techniques observed for delivering the classroom portion of the training. In the first, students were broken into groups, groups were assigned questions, given a few minutes to find the answer, then individuals had to read their question and answer to the class. Instructors added some extra points/knowledge when answering questions. This appeared to lead more to students finding answers to only the assigned questions -- reading for the answer, not for comprehension. It did get everyone involved to some extent. In the second technique, everybody read a certain section, and the instructor facilitated a discussion with leading questions – what were the key points, asked the questions from the book, solicited feedback and facilitated answers. It appeared that this technique obtained more discussion, interaction, and general participation from the audience. The instructor was able to highlight all key points and students weren't reading for a specific answer.

In terms of content related to the data analyses, researchers thought that there should be expanded materials on DUI, speeding, and conspicuity (see Strategies and Techniques to Improve Motorcycle Safety section). Since most crashes have driver error as the primary cause of the crash with speeding/too fast for conditions and DUI noted as common primary factors, these topics do not appear to be emphasized enough in the training topics. Stopping quickly is probably the most closely-related skill. These topics should have greater emphasis, especially in the classroom training. For example, while briefly discussed in the classroom, in only one of the training session attended did instructors have the "beer goggles" for participants to try (to simulate intoxication). Perhaps this simulation should be a standard section of the class. An overall impression was that there is little discussed on motorcycle crashes and the real-world dangers of motorcycles. Crash statistics or crash clips could be useful to drive the safety point home for students taking the course. Conspicuity was also an issue noted in the individual crash report reviews as well as the research literature. Greater emphasis should be placed on this item in the training.

Each classroom session also utilized videos. The videos were well produced and of good quality, informative, easy to watch, and of a proper length. However, rather than treating it as a break from the questions, it is recommended that a facilitated discussion occur after each of the videos so the class can debrief on key concepts that were covered. Instructors could better tie the videos in with the rest of the training materials.

The field facilities all appeared adequate though a few items were noted by researchers:

- At one location, there was a tractor trailer parked next to the riding course that was very close to where students were riding. It was noted by the instructor to be careful near there, but the truck shouldn't be there at all. Obstacles like this can be very dangerous especially for novice drivers.

- A small patch of diesel fuel which was quite slick was noted on the course near where the day's activities started. An instructor later put some sand on this spot, but the patch was in the riding route the rest of the day for everyone. There were no spill absorbent materials observed at any site.

- There were First Aid kits observed at each location, but they weren't mentioned by the instructors. Students should know where they are.

- A nut was found on the pavement halfway through one training day. It may have been prudent for instructors to stop exercises and complete a check of the bikes for loose or missing parts.

- It would be helpful to have a discussion at the start of the day on the importance of ensuring that equipment fits properly; also, that size and engine power of a motorcycle, together with physical stature and skill level of the driver, should be considered in choosing a bike – taking care not to ride a motorcycle that is too large or powerful for a driver's abilities.

Crash Report Reviews

To supplement the comprehensive set of data analyses described in the previous section of this report, we gathered a sample of 59 individual crash records from CDART to review for the purpose of developing an understanding of factors implicated in crashes at an individual level. This detailed review was completed paying particular attention to factors such as location, type of crash, roadway characteristics, weather and lighting conditions, and drivers' actions (actions of motorcycle drivers and actions of drivers of other vehicles if applicable, whether at fault or not, etc.). Researchers applied their expertise in roadway design, traffic studies, and crash analyses in this evaluation process. The following are some interesting points:

- Reviewed crashes were almost exclusively fatalities (only 1 exception).

- Date range was from 2001 to 2008 with the majority occurring from 2004-2008.

- DUI, speeding (or equivalent like driving too fast for conditions), and over/under compensating at curves were the top three factors mentioned which is consistent with the larger data analyses.

- When categorizing crashes, a simple way to review them was to characterize them as midblock or intersection crashes. However, upon review of the crashes, several crashes categorized as midblock, actually occurred at the intersection of a driveway. Of the 59 reports reviewed, 12 were "true" intersection crashes and 8 were classified as midblock, but occurred near the intersection of a driveway -- the collision involved a vehicle (either a motorcycle or other vehicle) pulling out of a driveway.

- For the 12 "true" intersection crashes, conspicuity (or lack thereof) of the motorcyclist was mentioned in the narrative as a factor in 7 of them (58%). Of the 8 "midblock-intersection" crashes, conspicuity (or lack thereof) of the motorcyclist was mentioned in 2, and may have been a factor in 3 additional ones (25% - 63%). If all of these are counted as intersections, this is a total of 45% - 60%.

- For the 7 of 12 "true" intersection crashes where conspicuity of the motorcyclist was mentioned in the narrative as a factor, only 1 occurred in dark conditions.

- Of the 59 reports reviewed, some had incomplete scans or had key sections missing (no crash narrative included, some pages missing, etc.).

- Of the 59 reports reviewed, 49 indicated driver error as the prime crash factor, 4 indicated environmental/roadway factors, 1 indicated vehicle factors, and 5 were unknown.

- Of the 59 reports reviewed, 25 occurred in dark (42%), 3 unknown, and 31 were in daylight.

- Of the 49 crashes with driver error as the prime crash factor, 11 were not the motorcyclists' fault with the possibility of 2 more (too hard to tell from description). Of the 11, 8 occurred at intersections/midblock-intersections (72%). One of the two unknowns occurred at an intersection.

- Of the 8 crashes that were at intersections/midblock-intersections that were not motorcyclists' fault, 7/8 (88%) and possibly all 8 appeared to have conspicuity (or lack thereof) of the motorcyclist as a factor.

- Key conclusion that was not based on Data Set 3 analyses was that *conspicuity* of the motorcyclists appears to be a significant factor in crashes. This is particularly significant at intersections where other drivers may not be seeing the motorcyclists approaching.

In sum, we integrated the qualitative and quantitative findings of this research to (a) provide an evaluation of the effectiveness of the PAMSP, (b) identify factors implicated in motorcycle crashes, and (c) identify strategies and techniques to improve motorcycle safety, along with a plan for successful statewide deployment.

Summary of Major Findings

Highlights of findings of analyses of Data Sets 1, 2 and 3 are summarized. Analyses of Data Sets 1 and 2 investigated factors that related to whether or not a driver crashed on a motorcycle. Data Set 1 included Pennsylvania drivers with an MBAC during the period 1990-2007. Data Set 2 included Pennsylvania drivers with PAMSP registration from 2004-2007. Analyses of Data Set 3 investigated factors related to crash outcomes, including all Pennsylvania drivers who crashed on a motorcycle during the period 1997-2007.

Key findings of Data Set 1 analyses (PA drivers with MBAC from 1990 – 2007):

- aggressive driving (according to records of driving violations) increases the likelihood of a motorcycle crash
- however, drivers with more violations may simply drive more, increasing crash likelihood due to greater exposure

Key findings of Data Set 2 analyses (PA drivers registered with the PAMSP from 2004-2007):

- drivers with higher PAMSP knowledge test scores were slightly *less* likely to crash
- drivers with higher PAMSP skills test scores were slightly *more* likely to crash, probably because they ride more and may be more likely to crash due to greater exposure

Key findings of Data Set 3 analyses (PA motorcycle drivers who crashed between 1997 – 2007):

Profiles of typical drivers who crashed reveal:

- female drivers in fatal crashes were 6 years older and 7 inches shorter than male drivers, and crashed 1.5 years sooner after initial MBAC
- sport bike drivers who crashed were much younger than cruiser drivers (25 vs. 42 years old)
- drivers without MBAC in fatal crashes were younger (27 years old) and more likely to be DUI at the time of the crash than other drivers profiled
- drivers with BRC pass in fatal crashes were older than BRC pass drivers in non-fatal crashes (39 vs. 32 years old), had more convictions for driving violations (2 or more vs. 1), and were less likely to have worn a helmet at the time of the crash

Key findings of Data Set 3 covariance structure models (PA drivers whose first motorcycle crash occurred between 1997-2007) concerning **DUI**:
- DUI at time of crash had a greater impact on injury severity than any other contributing factor in a crash, regardless of type of crash or type of motorcycle
- DUI played an even greater role in crash fatalities than injuries
- DUI drivers were less likely to wear a helmet than non-DUI drivers
- the strongest influence on DUI at crash is the number of DUI convictions on a driver's record
- drivers who passed a PAMSP course were substantially *less* likely to be DUI than drivers who did not take or pass a PAMSP course
- some drivers with records of multiple DUI convictions were less severely injured; they may have been driving more slowly while DUI to avoid detection, thus mitigating injury severity

Key findings of Data Set 3 models concerning **speeding**:
- speeding drivers were more severely injured than drivers who were not speeding
- speeding played a greater role in fatalities than injuries
- speeding had the greatest influence on injury severity for sport bike crashes, and the least for cruiser crashes
- DUI drivers were more likely to speed, regardless of type of motorcycle
- compared to DUI, speeding played a critical, yet lesser role in determining injury severity
- younger drivers were more likely to speed than older drivers
- males were more likely to speed than females
- driving with a history of speeding convictions increased the likelihood of speeding at the time of the crash

Key findings of Data Set 3 models concerning **MBAC:**
- drivers with MBAC sustained somewhat less severe injuries than drivers without MBAC
- MBAC drivers were more likely to wear a helmet than drivers without MBAC
- MBAC drivers were substantially less likely to be DUI at time of crash than drivers without MBAC
- older drivers were more likely than younger drivers to have an MBAC
- females were somewhat more likely than males to have an MBAC

Key findings of Data Set 3 models concerning **over-/under-compensation at curve,** and **inexperience**:

- over-/under-compensation at curve contributed to injury severity for single vehicle crashes
- inexperienced drivers suffered somewhat more severe injuries than experienced drivers, according to judgments of investigating officers recorded on crash reports

Key findings of Data Set 3 proportions of contributing factors to crashes:

- the biggest potential payoff of a reduction in drunk-riding would occur among cruiser drivers, because they have the greatest incidence of DUI both in terms of proportions and numbers
- a 50% reduction in incidence of DUI among cruiser drivers, holding other factors constant, would be expected to yield a reduction of 133 fatalities over 11 years of crash records studied, or about 12 fewer deaths per year
- a 50% reduction in incidence of speeding among all motorcycle drivers, holding other factors constant, would be expected to yield a reduction of 268 fatalities over 11 years of crash records studied, or about 24 fewer deaths per year
- if motorcycle drivers without Class M licenses or permits were properly licensed (having demonstrated the requisite knowledge and skills), we expect that they would drive more safely with fewer crashes
- wearing a helmet was associated with a greater likelihood of speeding among sport bike crashers; some sport bike drivers may regard the protection afforded by a helmet as providing a margin of safety that allows them to drive faster

Key findings of Data Set 3 odds ratios of contributing factors to crashes:

- odds ratios can be interpreted at the level of an individual driver, and thus lend themselves to marketing, informational, and educational messages to motorcycle drivers
- DUI, speeding, and not having an MBAC each increases the odds of a fatality in a crash; these factors in combination greatly increase the odds of fatality
- a DUI and speeding sport bike driver who crashed without an MBAC was 60 times more likely to die than a non-DUI, non-speeding sport bike driver with MBAC who crashed
- the odds of DUI at crash were 8 times greater for drivers with 1 or more DUI violations on record
- a motorcycle driver can substantially reduce his or her chances of severe injury and death in a crash -- information about odds can be used to educate drivers and help them to make better and smarter riding choices

Strategies and Techniques to Improve Motorcycle Safety

According to Data Set 3 analyses, the factors implicated in motorcycle crashes that have the greatest impact on the severity of crash outcomes are factors under the driver's control: DUI, speeding, wearing proper protective gear, training, and proper licensure. PennDOT can directly affect motorcycle safety through its relationship to drivers, including its ability to personally interact and communicate with them, its ability to inform and educate them, its ability to support them through training and licensing, and its ability to sanction them. PennDOT can also improve motorcycle safety using less direct means, through its partners in the law enforcement, training, education, motor vehicle safety, and motorcycle enthusiast communities. Ultimately, motorcycle safety is mostly in the hands of the motorcycle driver. We believe that PennDOT can make more effective use of its position vis a vis these drivers to guide them to better and safer choices and riding habits. Our strategies and techniques for motorcycle safety improvements build on PennDOT's established relationships with Pennsylvania drivers and the motorcycle driving community at large.

We believe that the quantitative and qualitative analyses and assessments presented in this report make a compelling case for the avenues for improvement that we describe below. We must first note a significant limitation to the available data for the quantitative analyses. As mentioned several times in previous sections, until very recently there was no measure available of driving exposure for motorcycle drivers. For purposes of this study, PennDOT does not know if a driver with a Class M license frequently, seldom, or never drives a motorcycle. PennDOT therefore has no way of knowing, for example, how many drivers who passed a PAMSP course drove safely without incident in the years following. PennDOT only actually knows that a driver was driving a motorcycle if he or she crashed it, and the crash was reported. These facts limit the inferences that can be drawn from the Data Set 1, 2, and 3 analyses. Most of the data-based findings of this report were drawn from analyses of Data Set 3, comparing characteristics of drivers who crashed and relating these to crash outcomes. Although the conclusions from these analyses are clear and compelling, we must nevertheless keep in mind that we studied a sample of motorcycle drivers who crashed. Several improvement strategies and techniques address the need to collect better data to guide future evidence-based practices.

Baldi, Baer, and Cook (Journal of Safety Research, 2005) provided a review of best practices in motorcycle driver education and licensing. They organized these practices in three major categories: (1) program administration, including integration of driver education and licensing practices, adequate and dedicated funding, and collection of driver training, licensing, and crash data; (2) driver education, including curricula, training delivery, outreach efforts, incentives for training, assessments and quality control, and instructor training; and (3) licensing, including a graduated licensing system, testing, license renewal practices, and incentives for licensing. It is important to recognize the overlapping and interacting nature of these components of motorcycle safety. In a similar vein, our improvement strategies and techniques are organized in terms of driver education and training, program administration, and licensing and enforcement. We believe that the synergies of PennDOT's efforts in each of these domains will yield substantial improvements in motorcycle safety.

Three primary themes underlie our suggestions for improvement strategies and techniques.

- First, the population of Pennsylvania motorcycle drivers is actually several distinct subpopulations that differ from one another along dimensions of driver age and gender, types of motorcycles driven, past driving safety records, and perhaps others. To be most effective, driver education initiatives should recognize these differences and take advantage of them in formulating particular messages and media.

- Second, individual drivers have individual crash risk profiles based on factors like age, gender, and past driving record. Understanding individual risk profiles would be beneficial to drivers, to PennDOT, and to others who promote motorcycle safety. To the extent possible, training and educating motorcycle drivers should take their individual risk profiles into account, as should PennDOT's sanctions for unsafe motorcycle driving.
- Third, to effectively address subpopulations of motorcycle drivers and account for their individual risk profiles, PennDOT must have better data than available currently, particularly concerning individual driving records that pertain to motorcycle driving.

Driver Education and Training

The analyses described in Task 2 provide some evidence for the effectiveness of BRC and ERC training, although as noted the research design is limited because very little information is available about trained vs. untrained motorcycle drivers who did not crash. On the other hand, our observations of BRC and ERC courses in several locations, participation by one of our research team members as a student in a BRC course, plus our review of training materials such as the BRC Rider Handbook and the ERC Classroom Cards, lead us to conclude that both courses are effective and worthwhile. We were particularly impressed as we watched students who had never been on a motorcycle at the beginning of a BRC course learn to become competent drivers by the end. We were equally impressed by the skill, care, and professionalism of BRC and ERC instructors.

It is our belief that everyone who intends to drive a motorcycle would benefit from BRC and/or ERC training. Indeed, we spoke to several students in both courses who stated that they retake these courses periodically (such as every two years) as a way to refresh their memories for the principles that are taught and to get individualized coaching to overcome bad driving habits. Although we do not think that PAMSP training should be a mandatory requirement for obtaining a Class M license, we think that all prospective motorcycle drivers who seek a Class M permit should be strongly encouraged to enroll in a PAMSP course.

1. Publicize PAMSP courses and their benefits. Increase marketing efforts to attract more participants, particularly among novice or aspiring motorcycle drivers. Develop messages tailored to specific market segments, and use appropriate media to reach the intended audiences (see 12-20 below also).

2. Expand the PAMSP capacity, with more classes offered to accommodate greater demand due to increased marketing. Perhaps offer classes in more locations. Expanding the capacity will reduce waiting periods for course enrollment availability, which at present may discourage prospective students.

3. For the BRC, expand the material in the Rider Handbook devoted to alcohol intoxication (Section H: Impairments). Cite statistics from this study and others concerning the role of DUI in increasing the probability of a crash and increasing the severity of crash outcomes. Explain the ways in which alcohol impairs driving ability and judgment, and how these effects increase the likelihood of a crash. Discuss ways to avoid drinking and riding, including avoidance of tempting situations such as riding with others who drink and ride. Include a self-assessment of risk based on factors such as age, gender, past record of DUI, and one's typical behavior patterns as a class discussion exercise (see 7 below).

4. For the BRC, add a section in the Rider Handbook that specifically addresses the hazards of speeding and associated risk of injury and death, including the increasing forces on a driver colliding with an object at increasing speeds. Emphasize that helmets and other protective gear do not provide a safety margin that allows one to drive faster. Include a self-assessment of risk based on factors such as age, gender, type of motorcycle, past record of speeding violations, and one's typical behavior patterns (including drinking and riding) as a class discussion exercise (see 7 below).

5. For the ERC, expand the discussion (and the related material in the ERC Classroom Cards) devoted to the hazards of DUI and speeding. Encourage students to self-assess their individual risks, and provide guidance on avoiding or minimizing these risks.

6. For the BRC and ERC, expand the discussion of conspicuity (visibility to other drivers). Cite statistics from this study and others concerning the role of motorcycle conspicuity in intersection and intersection-like (i.e., mid-block at driveway) crashes. Note that many conspicuity-related crashes occur in daylight. Show examples of bright colored clothing and use of reflective material on clothing, helmet, and motorcycle.

7. Develop a self-assessment of crash risk tool and make it available via the PAMSP website, BRC and ERC courses, and other venues as appropriate. This tool would pose a series of questions to the motorcycle driver and would provide a risk assessment in the form of increasing odds of severe injury or death in the event of a motorcycle crash. The crash risk tool would build on the information provided in Tables 25 - 27. The crash risk tool would also provide suggestions to reduce risk, including enrolling in a BRC or ERC course.

8. The Motorcycle Safety Foundation offers on-road skills courses, in addition to BRC and ERC. Consider offering a wider range of PAMSP courses to accommodate experienced drivers who wish to improve their skills.

9. The state of North Carolina has pioneered a program of one-on-one training/coaching for motorcycle drivers. Consider offering this as a PAMSP course option.

10. To address the problem of unlicensed motorcycle drivers (i.e., those without a Class M license or permit), require an unlicensed motorcycle driver who is charged with a driving violation to take and pass a PAMSP course, thereby receiving a Class M license, or face a 30-day license suspension.

11. Publicize the law and penalties for driving a motorcycle without a proper license or permit, including the facts that an unlicensed motorcycle driver who is stopped for a violation will not be allowed to drive from the scene (typically, the vehicle will be towed, or left at the scene until a properly licensed driver removes it), and that the driver will incur an improper license violation and a license suspension.

PAMSP Administration

As noted previously, we believe that PennDOT can make more effective use of its position with respect to motorcycle drivers to guide them to better and safer choices and riding habits. PennDOT has many opportunities, direct and indirect, to educate, communicate and interact with drivers. Many of these activities should draw upon the findings of this report to achieve maximum effectiveness. In particular, educational and other outreach efforts should incorporate the principles of market segmentation. To illustrate, we offer these suggestions for target audiences, messages, and media.

12. Target audience: General audience, aspiring motorcycle drivers.
    a. Messages: The importance and benefits of getting properly licensed (avoid points and sanctions; properly licensed drivers are safer), and getting training (must have an M license or permit to register for PAMSP course, which is free and imparts knowledge and skills that will make you a safer driver, teach you proper riding techniques.)
    b. Media: General media – print, radio, broadcast – plus avenues such as motorcycle dealerships, clubs (local chapters and online or virtual), national organizations (AAA, American Bikers Aimed Towards Education [ABATE], American Motorcyclist Association [AMA]), PennDOT website that provides information and resources.

13. Target audience: Motorcycle drivers without Class M license or permit (esp. young male drivers).
    a. Messages: The importance and benefits of getting properly licensed (avoid points and sanctions; properly licensed drivers are safer), and getting training (must have an M license or permit to register for MSP course, which is free and imparts knowledge and skills that will make you a safer driver, teach you proper riding techniques and help you break or avoid bad habits, recognize and avoid hazards, understand risks, meet other motorcycle drivers.)

b. Media: General media – print, radio, broadcast – plus avenues such as motorcycle dealerships, clubs (local chapters and online or virtual), national organizations (AAA, ABATE, AMA), medical personnel who treat injured motorcycle drivers, PennDOT website that provides information and resources, including a self-assessment tool for crash risk.

14. Target audience: Motorcycle drivers who are unlikely to take a PAMSP course, segmented according to age (<30, >=30).
    a. Messages: PAMSP courses are free and impart knowledge and skills that will make you a safer driver, teach you proper riding techniques and help you break or avoid bad habits, recognize and avoid hazards, understand risks, meet other motorcycle drivers.
    b. Media: General media – print, radio, broadcast – plus avenues such as motorcycle dealerships, clubs/communities (local chapters and online or virtual), national organizations (AAA, ABATE, AMA), medical personnel who treat injured motorcycle drivers, PennDOT website that provides information and resources, including a self-assessment tool for crash risk.

15. Target audience: Sport bike drivers (esp. young male drivers)
    a. Messages: Speed kills – sport bike drivers killed in crashes are likely to have been speeding – if you have a record of one or more speeding violations, you are at particular risk. Slow down, always wear proper protective gear, be as visible as possible to other drivers.
    b. Media: Motorcycle dealerships, clubs/communities (local chapters, rallies, etc., and online or virtual), national organizations (AAA, ABATE, AMA), medical personnel who treat injured motorcycle drivers, PennDOT website that provides information and resources, including a self-assessment tool for crash risk. Peers, especially peers who crashed and learned a lesson the hard way may be particularly effective.

16. Target audience: Cruiser drivers (esp. males over age 35)
    a. Messages: DUI kills, speed kills, in combination they are especially deadly. Cite statistics about cruiser drivers killed in crashes likely to have been DUI and speeding – if you have a record of one or more DUI and/or speeding violations, you are at particular risk. Don't drink and ride, don't ride with riders who do, slow down, always wear proper protective gear, be as visible as possible to other drivers.
    b. Media: Motorcycle dealerships, clubs/communities (local chapters, rallies, etc., and online or virtual), national organizations (AAA, ABATE, AMA), medical personnel who treat injured motorcycle drivers, PennDOT website that provides information and resources, including a self-assessment tool for crash risk. Peers and spouses.

17. Target audience: Novice drivers (esp. cruiser drivers over age 30)
    a. Messages: Get training before you ride, ride a suitable bike (size, power), don't ride beyond your abilities, don't borrow someone else's bike that may be too big/powerful for you.
    b. Media: Motorcycle dealerships, clubs/communities (local chapters, rallies, etc., and online or virtual), national organizations (AAA, ABATE, AMA), medical personnel who treat injured motorcycle drivers, PennDOT website that provides information and resources, including a self-assessment tool for crash risk. Peers and spouses.

18. Target audience: Drivers with prior DUIs (esp. male cruiser drivers)
    a. Messages: DUI kills, speed kills, DUI encourages speeding, in combination they are especially deadly. Cite statistics about cruiser drivers killed in crashes likely to have been DUI and speeding – if you have a record of one or more DUI and/or speeding violations, you are at particular risk. Don't drink and ride, don't ride with riders who do, slow down, always wear proper protective gear, be as visible as possible to other drivers.
    b. Media: Motorcycle dealerships, clubs/communities (local chapters, rallies, etc., and online or virtual), national organizations (AAA, ABATE, AMA), medical personnel who treat injured motorcycle drivers, PennDOT website that provides information and resources, including a self-assessment tool for crash risk. Peers and spouses.

19. Target audience: Drivers with prior Speeding Violations (esp. younger male sport bike drivers)
    a. Messages: Speed kills – younger male drivers killed in crashes are likely to have been speeding, especially sport bike drivers – if you have a record of one or more speeding violations, you are at particular risk. Slow down, always wear proper protective gear, be as visible as possible to other drivers.
    b. Media: Motorcycle dealerships, clubs/communities (local chapters, rallies, etc., and online or virtual), national organizations (AAA, ABATE, AMA), medical personnel who treat injured motorcycle drivers, PennDOT website that provides information and resources, including a self-assessment tool for crash risk. Peers, especially peers who crashed and learned a lesson the hard way may be particularly effective.

20. Target audience: Drivers with multiple violations and sanctions (anyone who fits this profile)
    a. Messages: DUI kills, speed kills, DUI encourages speeding, in combination they are especially deadly. Cite statistics about drivers killed in crashes likely to have been DUI and speeding – if you have a record of one or more DUI and/or speeding violations, you are at particular risk. Don't drink and ride, don't ride with riders who do, slow down, always wear proper protective gear, be as visible as possible to other drivers.

   b. Media: Motorcycle dealerships, clubs/communities (local chapters, rallies, etc., and online or virtual), national organizations (AAA, ABATE, AMA), medical personnel who treat injured motorcycle drivers, PennDOT website that provides information and resources, including a self-assessment tool for crash risk. Peers and spouses.

21. Establish a speakers' bureau to make knowledgeable experts available to motorcycle enthusiast and other interested community groups for presentations on motorcycle safety. Create a PowerPoint presentation to support this initiative. The presentation should include information for motorcycle drivers, and for other drivers with tips on detecting motorcycles on the road.

22. Expand PennDOT's capabilities for recording and utilizing information stored in driving records concerning motorcycle drivers. In particular, record the type of vehicle driven for each driving violation, so that violators who were driving a motorcycle can be easily identified. Record the type of motorcycle driven according to the type of motorcycles described in the MSF Rider Handbook (touring, cruiser, sport, standard, scooter, etc.). Use this information to identify typical driver characteristics and violation patterns, and to tailor educational and sanctioning practices.

23. Continue to measure annual motorcycle miles driven using roadway measuring devices suitable to this purpose. Continue to require drivers who renew motorcycle registrations to report annual miles driven. Track improvements in motorcycle safety using enhanced violation records and crash statistics. Relate these to market segments to determine the effectiveness of safety improvement initiatives by segment.

Licensing and Enforcement

24. Work with partners to address unlicensed motorcycle, DUI, and speeding drivers through better enforcement of existing laws. Encourage police to issue citations for all violations, including improper license, not only for the violation for which the driver was stopped. Provide up-to-date information to judges/magistrates about the findings of this study concerning DUI and speeding, and training options.

25. Work with partners such that when a motorcycle comes through a checkpoint (of any type) and the driver is found to be improperly licensed, the officer should have available information brochures for licensing and PAMSP training, and should issue an improper license citation at the officer's discretion (especially if not the first time stopped without a proper license or permit).

26. Screen for motorcycle drivers at departmental hearings (speed hearings, young driver hearings, Type II and Type III hearings, etc.). For any driver who committed a DUI, speeding, or reckless driving violation while driving a

motorcycle, the examiner should review the driver's record, counsel the driver on safe riding, and present the driver with two options: (a) pass a PAMSP course, or (b) receive a 60-day license suspension. Findings of this study show that a poor driving record is predictive of behaviors associated with motorcycle crashes and crash outcomes. PennDOT should use its role in license administration to address drivers who have demonstrated unsafe driving of a motorcycle.

In Appendix H we provide rough estimates of implementation parameters for these improvement strategies and techniques, including use, impact, resources required, and time to implement. For market segment outreach strategies, we indicate which media may be particularly well suited to each market segment.

Appendix I includes annotated PowerPoint slides for the final report oral presentation.

Evaluation of Pennsylvania's Motorcycle Safety Program

Final Report Appendices

Submitted to:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

Safety Administration
Bureau of Driver Licensing
1101 South Front Street – 4th Floor
Harrisburg, PA 17104

Submitted By:
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July 27, 2009

Vance & Renz, LLC
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Table of Contents

Appendix A:
Survey of Other State Motorcycle Safety Programs

Motorcycle Safety Program Evaluation Survey

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

- ◯ Yes
- ◯ No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: ☐

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

- ◯ Yes
- ◯ No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: ☐

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Please provide your name, title, address, telephone, and email.

Name:

Title:

Address:

Telephone:

Email:

May we contact you if we have additional questions or need to clarify your responses?

- Yes
- No

Would you like a copy of the results of our study?

- Yes
- No

Thank you for your responses. If you have any questions about this study, please contact Dr. Robert J. Vance at 814-231-8155 or bob@vancerenz.com. Please mail any reports or documentation not available online to:

Dr. Robert J. Vance

Vance & Renz, LLC
606 Wayland Place
State College, PA 16803

Submit

1. Robert D. Secrest
Coordinator, Motorcycle Ohio
1970 W. Broad St.
Columbus, OH 43223

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Yes, We piloted and now will offer a BRC-2 course for the returning rider and individuals that have had multiple permits. This is a one day course and we will offer the skill test waiver upon successful completion. See www.motorcycle.ohio.gov for more info under the Basic Rider Course.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Our BRC-2 will go statewide in 2008.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:
Contact me at bsecrest@dps.state.oh.us and I will email you the report.
If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

BRC Course BRC-2 Course ERC Course The above three are approved by the Motorcycle Safety Foundation. You can contact them for specfic data.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

State Skill Test Waiver - By giving the waiver to those who successfully complete the BRC or BRC-2, it is encouraging those individuals who have been riding on multiple temps or no permit at all, to take a safety course that will provide them their endorsement.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

MO received $6 from each license plate renewal each year that is deposited in a motorcycle education fund for the Motorcycle Ohio program. MO has on-line registration which has proven to assist individuals to register quickly for a class and also reduces the paperwork in the MO office. MO has a database which keeps track of all individuals that register and take a course. We can track our pass/fail rate, gender, minors and age. The state tracks the crash data for motorcycles and reports can be generated.

Please provide your name, title, address, telephone, and email.

Name: **Robert D. Secrest**

Title: **Coordinator, Motorcycle Ohio**

Address: **1970 W. Broad St.**
Columbus, OH 43223

Telephone: **614-466-4041**

Email: **bsecrest@dps.state.oh.us**

May we contact you if we have additional questions or need to clarify your responses? **Yes**

Would you like a copy of the results of our study? **Yes**

---

2. MAJ Gerald Davidson, Oklahoma Highway Patrol
Administrator for MC Safety and Education Program
PO Box 11415
Oklahoma City, OK 73136-0415

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Assigned an administrator over the program to develop a pro-active effort.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

None other that building upon what is getting started.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Encouraging cyclists to take advantage of the MSF sanctioned training; public information and education efforts directed towards motorcycle riders to drive responsibly; public information and

education efforts directed towards the motoring public to share the road with motorcycles. Results in all of the motoring public to understand their responsibilities to enhance traffic safety. And through training, may result in a more competent rider.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

   Educating prospective motorcyclist of their responsibilities in obtaining a motorcycle endorsement; state statute was enacted that allows law enforcement officers to impound a vehicle if the person does not have the licensing privileges to operate the vehicle (no endorsement, L.E. can tow the motorcycle). Works toward ensuring qualified riders are operating motorcycles.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective? (Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

   Enhanced crash data collection that results in nearly real time data (within about two weeks); awarding of grants through the National Highway Traffic Safety Administration to go towards motorcycle safety; continued efforts to seek out ways for sustained funding. More accurate and timely crash data allows for better problem identification. All safety education programs have costs associated with them. Long term programs are necessary to effect a behavior change for some motorist to drive in safe and responsible manners.

Please provide your name, title, address, telephone, and email.

Name: **MAJ Gerald Davidson, Oklahoma Highway Patrol**

Title: **Administrator for MC Safety and Education Program**

Address: **PO Box 11415**
Oklahoma City, OK 73136-0415

Telephone: **(405)425-7705**

Email: **gdavidso@dps.state.ok.us**

May we contact you if we have additional questions or need to clarify your responses? **Yes**

Would you like a copy of the results of our study? **Yes**

---

3. Ken Kiphart
   Motorcycle Program Administrator
   555 Wright Way
   Carson City, NV 89711

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

We have added three wheel training to our available courses.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Adding efforts to meet with motorcycle groups to encourage not drinking when riding.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

rider education, motorists awareness, recruiting new instructors.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Providing a license waiver course for the experienced rider.
Promoting this course through media.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

FARS analysis, dedicated funds, license waiver with DMV.

Please provide your name, title, address, telephone, and email.

Name: **Ken Kiphart**

Title: **Motorcycle Program Administrator**

Address: **555 Wright Way**
Carson City, NV 89711

Telephone: **775-684-7480**

Email: **nvrider@dps.state.nv.us**

May we contact you if we have additional questions or need to clarify your responses? **Yes**

Would you like a copy of the results of our study? **No**

---

4. Toni Kerkove
MRE Administrator
2060 Crossroads Blvd
Suite 103
Waterloo, IA 50702

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

We changed the way the MC fund is used. Only a small portion is retained for expenses incurred while the remainer of the fund is divided amongst the program sponsors.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

We have discussed some viable options but nothing that can be released at this time

---

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1) Under 18 must take the rider training course. We are training the new riders on how to be a more responsbile cyclists 2) Remedial training - for those that fall short in the course, they can take the additional time necessary to hone their skills to become safer more responsible riders. 3) Share the Road program. We are getting to the students and older drivers through presentations so they are more keen to watching out for cyclists while traveling on roadways.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1) Drive dates. We have 3 dates each quarter that require a person whether they have taken the course or not to drive with the DOT - sort of a random sampling of the students who take the course 2) IP's are not renewable. They cannot continue to be a permit holder and not take the required course or test to be fully endorsed. They must show their skill to get the full license 3)

7. What are the top three *program administration practices* that contribute to

safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

1) The DOT Alternate Most test may be waived upon successful completion of the rider education course. 2) Each person that has the motorcycle endorsement will pay an additional $1.00 per year of validity to help support the rider education program. 3) The driver license system tracks people who have taken the rider education course and can easily be linked with crash data.

Please provide your name, title, address, telephone, and email.

Name: **Toni Kerkove**

Title: **MRE Administrator**

Address: **2060 Crossroads Blvd**
Suite 103
Waterloo, IA 50702

Telephone: **319-235-8032**

Email: **toni.kerkove@dot.iowa.gov**

May we contact you if we have additional questions or need to clarify your responses? **Yes**

Would you like a copy of the results of our study? **Yes**

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5. Kurt Stromberg
Motorcycle Education Coordinator
PO Box 30560
Salt Lake City Utah 84130-0560

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

   No changes

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

   Yes, but I can't elaborate at this time.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that

examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:
A study
If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

   No

   If 'Yes' and a report is available electronically, please provide a website address:

   If a report is available only in hardcopy, please mail it to the address below.
   If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
   (Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Please provide your name, title, address, telephone, and email.

Name: **Kurt Stromberg**
Title: **Motorcycle Education Coordinator**
Address: **PO Box 30560**
Salt Lake City Utah 84130-0560

Telephone: **801-964-4493**

Email: **kstromberg@utah.gov**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

6. Joseph M. Tyree
   Program Coordinator
   2 Hale Street, Suite 100
   Charleston, WV 25301

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Yes added the ERC Wavier

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Possible three wheel training

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

BRC ERC Alternate Most

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Awareness program dedicated funds for ridwers education and training

Please provide your name, title, address, telephone, and email.

Name: **Joseph M. Tyree**

Title: **Program Coordinator**

Address: **2 Hale Street, Suite 100**
Charleston, WV 25301

Telephone: **304-558-1041**

Email: **jtyree@dot.state.wvc.us**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

7. Paul A. Graves
Vermont Rider Education Program Coordinator
120 State Street
Montpelier, VT 05603-0001

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Yes. The program is currently implementing a motorcycle awareness program. The program designed as a pre-permit course. The program is also using the MSF Experience Rider License Waiver Course as a way to provide training to unlicensed (riders with permits) riders who feel the Basic RiderCourse does not meet their requirements.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

No.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Please provide your name, title, address, telephone, and email.

Name: **Paul A. Graves**

Title: **Vermont Rider Education Program Coordinator**

Address: **120 State Street**
Montpelier, VT 05603-0001

Telephone: **802-828-2068**

Email: **paul.graves@state.vt.us**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

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8. Fred Zwonechek
Nebraska Highway Safety Administrator
P.O. Box 94612
Lincoln, NE 68509

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Nebraska has expanded the number of training sites. Beginning 2004, we switched from the MSF:RSS to the MSF:BRC, along with revizing ranges and training instructors.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

The training program is self sufficient with funding from fees from registered motorcycles, mc operators licenses, and course registration fees. Therefore, we are using federal highway safety Section 2010 funding to pay for a motorcycle safety awareness media

(billboards, movie theater ads, radio/tv ads, etc.)campaign effort. In addition, we are utilizing state funding to promote motorcycle rider appropriate riding gear media campaign. Continued detailed motorcycle crash data made available to policy makers and the public to identify crash facts and contributing circumstances.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

N/A

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

N/A

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?

(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Encouraging the completion of basic and experienced rider courses to waive the written and rider examinations at the DMV. In addition, we have added to the driver record whether they have completed the rider training courses.

Please provide your name, title, address, telephone, and email.

Name: **Fred Zwonechek**

Title: **Nebraska Highway Safety Administrator**

Address: **P.O. Box 94612**
Lincoln, NE 68509

Telephone: **402-471-2515**

Email: **fredz@notes.state.ne.us**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

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9. Glenn Davis
Impaired Driving Programs Manager
Coloraod Department of Transportation
4201 E. Arkansas Ave
Denver, Co 80222

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Review of Rules process (Outdated) NHTSA Assesment of State Motorcycle Safety Program

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

NO

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

State rules dictate standard ciriculum. State quality and assurance reviews of state trainers Addressing NHTSA asssesment recomendations

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Contact Rod Ruder at rod.ruder@spike.dor.state.co.us

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Licensing requirements State sponsered training NHTSA reccomendations from assessment

Please provide your name, title, address, telephone, and email.

Name: **Glenn Davis**

Title: **Impaired Driving Programs Manager**

Address: **Coloraod Department of Transportation**
4201 E. Arkansas Ave

Denver, Co 80222
Telephone: **303 757 9462**
Email: **glenn.davis@dot.state.co.us**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

10. Tom Wright
State Administrator, MSEP
NJ Motor Vehicle Commission
225 East State Street
PO Box 131 - 8 West
Trenton, NJ 08666

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Yes. 1- Legislation was enacted that allows new motorcycle dealerships to offer the motorcycle safety program. 2- The program was transferred from the Division of Highway Traffic Safety to the Motor Vehicle Commission. This change places the oversight of the program in the same agency that oversees driver testing and licensing. 3- A public relations campaign was introduced in June 2007 aimed at sharing the road messages to motorists.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Yes. 1- Laws and regulations are being evaluated to provide more incentives to riders to take part in education programs. 2- We are in the planning phases of expanding the offer to be able to offer the classes at more locations throughout the state.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:
A study is beginning. We are now in the planning stages.

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1- Increasing locations offering the motorcycle safety course. 2- Motorist awareness campaigns, i.e. billboards, tollbooth signs, and radio messages during traffic reports. 3- A website dedicated to New Jersey rider education program was established. www.njridesafe.org

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

We are reviewing all the the current motorcycle licensing requirements and recommending revisions to provide incentives versus mandates for riders to elect to participate in the programs. A rider who chooses to take part in a training program is more likely to derive a benefit from the program information.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Rider training was integrated with the licensing entity in 2005. This cooperative effort allows the implementation of a holistic approach to program improvements. The program has a dedicated funding source that provides a consistent budget for planning and operational purposes. The program is less affected by statewide budgetary restraints.

Please provide your name, title, address, telephone, and email.

Name: **Tom Wright**

Title: **State Administrator, MSEP**

Address: **NJ Motor Vehicle Commission**
225 East State Street
PO Box 131 - 8 West
Trenton, NJ 08666

Telephone: **609-633-9488**

Email: **tom.wright@dot.state.nj.us**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

11. Michele Calvert
Director, Montana Motorcycle Rider Safety
PO Box 7751
Havre, MT 59501

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

No

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

No

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Crashes, fatalities are increasing.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

My agency does not handle licensing

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Integrated rider education & licensing and dedicated funding for rider education. People are getting safety training and having the skill test waived for the motorcycle endorsement.

Please provide your name, title, address, telephone, and email.

Name: **Michele Calvert**

Title: **Director, Montana Motorcycle Rider Safety**

Address: **PO Box 7751**
Havre, MT 59501

Telephone: **(406) 265-3565**

Email: **mcalvert@msun.edu**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**No**

12. Louie Kyler
Florida Rider Training Program Manager
2900 Apalachee Parkway
Room B214, MS #88
Tallahassee, FL 32399

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

No.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

As of July 1, 2008 rider training will be required by anyone seaking a motorcycle endorsement. Also an endorsement will be required to registar a motorcycle.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:
We compared trained riders to fatel crashes and found that less than 5% were trained.
If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

As most states we have experienced an increase in fatalities but we have also had an increase in motorcycle purchases. Currently those under 21 have to take the training and as of July 1, 2008 everyone, reguardless of age, will have to complete the training.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Again, we are moving to mandated training and based on current stat indicating that less than 5% of fatal motorcycle crashes involved trained riders we should see a decrease in fatal crashes.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

We currently have intergratino and rider education and licensing, dedicated funding for rider education and we are working on a system to connect licensing to crash data.

Please provide your name, title, address, telephone, and email.

Name: **Louie Kyler**

Title: **Florida Rider Training Program Manager**

Address: **2900 Apalachee Parkway**
Room B214, MS #88
Tallahassee, FL 32399

Telephone: **407-719-5022**

Email: kyler.louie@hsmv.state.fl.us

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

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13. Wayne Steele
Program coordinator
250 Stratton Bldg. Rm 216
521 Lancaster Ave. Eastern KY University
Richmond, KY 40475

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

No major changes. We have clarified smaller details with our Policies and Procedures. i.e. Having waiver forms notarized

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

We have a proposal to offer the ERC and the Advanced Course (SERC) free to those students who have successfully completed the BRC. Three courses for the cost of one.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Offering of RiderCourses in a timely fashion. The waiting period to take a class is less than thirty days. Presentations (Host An Event) conducted by the Public Address Officers for the State Police. Continuing to support the development of the RiderCoaches and their understanding of a Learner Centered approach.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Offering the Skills Test Waiver Completion Card for the BRC. Offering the Waiver for successful completion of the ERC. We offer a re-test for unsuccessful students later the same day. Offer a practice test online for obtaining the temporary license (permit)

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

We have dedicated funds for motorcycle training. Those funds are motorcycle users fees only. The rider education data is shared with the Legislation Research Committee to be included in the total report which includes licensing and permits by counties (120) then compared to the crash data by the state police. * We feel our contributions are only a small part to the overall needed comprehensive plan to reduce crashes and fatalities.

Please provide your name, title, address, telephone, and email.

Name: **Wayne Steele**

Title: **Program coordinator**

Address: **250 Stratton Bldg. Rm 216**
521 Lancaster Ave. Eastern KY University
Richmond, KY 40475

Telephone: **859-622-1153**

Email: **wayne.steele@eku.edu**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

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14. Ronald G. Carty
State Program Coodinator
Motorcycle Rider Education
SC Technical College System
111 Executive Center Drive
Columbia, SC 29210-8424

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

We introduced an Intermdiate Course (IC) to fill the gap between the BRC and EC. The IC consists of selected exercises from the BRC and allows students to use personnel motorcycles. The Program Coordinator was recently moved to a position within the State Technical College System. This was done to provide better oversight of the program.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

We are evaluating the overall training program through a Team made up of Rider Coaches and Technical College Program Managers. We are pursuing a campaign to advertise motorcycle training more readily to the public. The State of South Carolina has formed a Task Force to study motorcycle accidents and make motorcycle safety awareness training available to all vehicle drivers, not only motorcycles riders.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Not available at this time

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Not available at this time

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Process in work

Please provide your name, title, address, telephone, and email.

Name: **Ronald G. Carty**

Title: **State Program Coodinator**

Address: **Motorcycle Rider Education**
SC Technical College System
111 Executive Center Drive
Columbia, SC 29210-8424

Telephone: **803-896-5266**

Email: **carty@sctechsystem.edu**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

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15. P.J.Janik
Council Member; Arizona Motorcycle Safety Council
c/o
Prescott Valley Police Dept.
7601 Civic Circle
Prescott Valley, AZ. 86314

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Yes. We have become a more visable resource to the motorcycle community by pursuing outside grant funding from USDOT and other sources in order to provide better motorcycle safety education. Also, $1.00 per every motorcycle registration is directed towards the Arizona Motorcycle Safety Advisory Council.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Recently we had an assessment completed by USDOT team on Arizona motorcycle safet program and the Motorcycle Safety Advisory Council. We are awaiting the results of that asssessment.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1. Qualified Rider Training 2. Impaired driver 3. Motorist Awareness of motorcyclists.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1. Qualified Rider Training is probably the biggest factor we are working on today. Encouraging motorcyclists to obtain rider training

through the Motorcycle Safety Foundation or other qualified source, it will greatly benefit our overall operator licensing.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective? (Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

1. Grant funding aimed towards motorcycle operator education 2. Motorist education of motorcyclists 3. Motorcyclist Impairment

---

Please provide your name, title, address, telephone, and email.

Name: **P.J.Janik**

Title: **Council Member; Arizona Motorcycle Safety Council**

Address: **c/o**
Prescott Valley Police Dept.
7601 Civic Circle
Prescott Valley, AZ. 86314

Telephone: **(928) 772-5115**

Email: **pjjanik@pvaz.net**

May we contact you if we have additional questions or need to clarify your responses? **Yes**

Would you like a copy of the results of our study? **No**

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16. Eric
Driver Education Program Manager
29 State House Station
Augusta, ME 04333

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

No.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

No.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

We currently have three rider education courses; Maine Motorcycle Safety Education Course (MMSEC)8 hours classroom only; MSF's Basic Rider Course; Msf's Experienced Rider Course.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

N/A

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

N/A

Please provide your name, title, address, telephone, and email.

Name: **Eric**

Title: **Driver Education Program Manager**

Address: **29 State House Station**
Augusta, ME 04333

Telephone:

Email: **Eric.bellav**

May we contact you if we have additional questions or need to clarify your responses? **No**

Would you like a copy of the results of our study? **No**

17. Bruce Biondo

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

We went from contract for the training to a Training Site License. We did this to allow a public/private partnership

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

We are going to do more awarness geared toward the motorcycle rider.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Basic Rider Course, Experencied Rider Coure and sidecar/tryke training program.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Knowledge and skill test.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

We have dedicated funding for rider education.

Please provide your name, title, address, telephone, and email.

Name: **Bruce Biondo**
Title:
Address:
Telephone: **8043671813**
Email: **bruce.biondo@dmv.virginia.gov**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

18. Franklin Garcia
Staff Manager
NMDOT Traffic Safety Bureau
PO Box 1149

Santa Fe, NM 87504-1149

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Adjustment of training sites statewide to match need.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Utilizing SAFETEA-LU funding for additional public awareness campaign.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1. Annual crash report has specific motorcycle crash data. Useful in

training, support for motorcycle training, awareness 2. Increase in public awareness. Purchased media rather than PSA. DOT chooses locations. 3. Conduct annual motorcycle advisory meeting with multi-jursidiction. Provides DOT with input on program improvements from several areas.**

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1. DOT approved training certificate will waive MVD written and road test. Riders would rather take MSF training to avoid wait at MVD. 2. DOT will start to track endorsement status in 2008 when reviewing all motorcycle crashes. This will provide opportunity to promote rider training. 3. Good communication between DOT (motorcycle oversight agency) and MVD (licensing).

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

1. New Mexico has designated funding for motorcycle program. 2. New Mexico applied/received SAFETEA-LU funding for motorcycle program improvements and enhancements. 3. New Mexico contracts with Motorcycle Safety Foundation to provide training statewide. Great relationship and program.

Please provide your name, title, address, telephone, and email.

Name: **Franklin Garcia**

Title: **Staff Manager**

Address: **NMDOT Traffic Safety Bureau**
PO Box 1149
Santa Fe, NM 87504-1149

Telephone: **(505) 827-3200**

Email: **franklin.garcia@state.nm.us**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

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19. Jean Cooper
Acting Chair, Arizona Motorcycle Safety Advisory Council
846 W Earll Drive
Phoenix, AZ 85013

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

none, there is no formal motorcycle safety program in Arizona at this time. Arizona does have an advisory ouncil that produced an ad (billboards, printed material and radio/TV spots) aimed at educating the public regarding mrotorcycle safety.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

The advisory council is consistently investigating ways to educate the public and motorcyclists regarding safety. The state is considering instituting a Program.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

N/A

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

N/A

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

N/A

Please provide your name, title, address, telephone, and email.

Name: **Jean Cooper**

Title: **Acting Chair, Arizona Motorcycle Safety Advisory Council**

Address: **846 W Earll Drive**
Phoenix, AZ 85013

Telephone: **602-616-9855**

Email: **azjkc@aol.com**

May we contact you if we have additional questions or need to clarify your responses? **Yes**

Would you like a copy of the results of our study? **Yes**

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20. William F. Pautler
Program Manager - Motorcycle Safety Program
NYS Department of Motor Vehicles
6 Empire State Plaza, Room 414
Albany, New York 12228

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

No

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Possibly, with the results of a scheduled NHTSA Motorcycle Safety Program assessment, DMV may redirect its efforts.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Providing the road test waiver for completing the BRC Supporting a rider-funded safety program Sponsoring the SMSA conference for professional development of our RiderCoaches

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Requiring a license endorsement Providing the road test waiver for completing the BRC

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

A legislated rider-funded program assures consistent program funding. Partnership with the Governor's Traffic Safety Committee

Conducting motorist awareness public information campaigns.

Please provide your name, title, address, telephone, and email.

Name: **William F. Pautler**

Title: **Program Manager - Motorcycle Safety Program**

Address: **NYS Department of Motor Vehicles**
6 Empire State Plaza, Room 414
Albany, New York 12228

Telephone: **518 473-7700**

Email: **wpaut@dmv.state.ny.us**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

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21. Despina Metakos
Motorcycle Safety Coordinator
2 CaptiolHill Room 106

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Until 2006 RI had NO Motorcycle Safety Coordinator. One was hired in 2006 and developed a motorycle saftey program geared toward educating both rider and driver alike.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

We are in the process of developing media campaigns that target both driver and rider.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

We are in the infancy of our program and do not have sufficient data to determine the effectiveness of our program.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Our Licensing program is directly tied to our Motorcycle Safety Classes. A person can not obtain a MC license without taking and finishing the 16 hour BRC.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Rhode Island mandates a 16 hour training class prior to obtaining a MC license. Mandatory Classes, assure the rider can ride at a basic skill level and pass a both a skills test as well as a written test before a MC endoresement is given. RI also has a MC safety program dedicated to outreach to bikers and riders alike. We also collect and analyze crash data to determine the cause of the crash and if any geometric issues contributed to the crash make every effort to correct them in a timely manner.

Please provide your name, title, address, telephone, and email.

Name: **Despina Metakos**

Title: **Motorcycle Safety Coordinator**

Address: **2 CaptiolHill Room 106**

Telephone: **401-222-3024**

Email: **dmetakos@dot.ri.gov**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

22. Ron Thompson
Motorcycle Safety Program Manager
4802 Sheboygan Ave. Room 551
PO Box 7936
Madison, WI 53707-7936

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Revised administrative rules. To be current with curriculum standards and state needs. Revised policies and procedures manual. To be current with curriculum standards and state needs.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Following the NHTSA motorcycle program assessment next week, I am sure that we will have several changes to consider.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Funding courses vis the Wisconsin Technical College System. 10,000 students trained annually.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Requiring course attendance after holding three permits. Requiring course attendance after two skill test failurs. Requiring course attendance under age 18. All of the above get riders into the BRC courses.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

Adequate program funds. We offer over 800 courses annually. Law enforcement extraordinary enforcement efforts at motorcycling events. Rduces crashes. Driver, crash,registration and student files are in place. we hope to having them "talk"to each other in 2008 to do analysis on our effectiveness and make appropriate changes as needed.

Please provide your name, title, address, telephone, and email.

Name: **Ron Thompson**

Title: **Motorcycle Safety Program Manager**

Address: **4802 Sheboygan Ave. Room 551**
PO Box 7936
Madison, WI 53707-7936

Telephone: **608-266-7855**

Email:

May we contact you if we have additional questions or need to clarify your responses? **No**

Would you like a copy of the results of our study? **No**

23. Janice Campbell
Sergeant
2555 First Avenue
Sacramento, CA 95818

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

1. Implemented the MSF Basic RiderCourse curriculum to bring state of the art motorcycle rider education to CMSP. 2. Implemented a new contract structure that forces accountability for student safety and satisfaction as well as budget efficiency to preserve the integrity of the program and drive efficient use of available funding. 3. Implemented a comprehensive quality assurance program. The results are directly available to the state agency, training providers, and RiderCoaches. Every state program training site recieves a minimum of two half-day quality assutance visits each year. This quality assurance program reinforces RiderCoach, training provider, and contractor accountability to the state agency and students. 4. Quality assurance process results drive professional development activities. Results of the quality assurance process point to topics and trends that are addressed at the annual professional development workshops. 5. Annual, mandatory, professional development workshops for all state-recognized RiderCoaches ensures standardization in administering the state approved curriculum and assures quality in the delivery of training to students. It also fosters a healthy working relationship among the state-recognized RiderCoaches.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

Strategies and action items have been submitted for review and approval to the Strategic Highway Safety Plan Steering Committee.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

   No

   If 'Yes' and a report is available electronically, please provide a website address:

   If a report is available only in hardcopy, please mail it to the address below.
   If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

   N/A No research available to determine effectiveness.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

   N/A No research available to determine effectiveness.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
   (Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

   N/A No research available to determine effectiveness.

Please provide your name, title, address, telephone, and email.

Name: **Janice Campbell**

Title: **Sergeant**

Address: **2555 First Avenue**
Sacramento, CA 95818

Telephone: **(916) 657-7222**

Email: **jacampbell@chp.ca.gov**

May we contact you if we have additional questions or need to clarify your responses? **Yes**

Would you like a copy of the results of our study? **Yes**

24. Michele O'Leary
Motorcycle Safety Program Manager
235 Union St. NE
Salem, OR 97301

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

Yes. TEAM OREGON stopped using the MSF curriculum in 2003. A study was conducted that determined there were deficiencies in the MSF course. Consequently, TEAM OREGON has developed their own set of training courses.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

We will be undertaking more efforts to address the unlicensed rider. Other than that, no changes are anticipated.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1) Research into Oregon motorcycle crash causation factors; 2) curriculum design and content designed to treat crash causation factors; 3) overlearning critical skills identified in research - range drills emphasize correct methods and provide riders repeated practice and more miles.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

1) Require riders under 21 years of age to complete an approved rider education course. Ensures that novice riders receive training. 2) Allow test waivers for completion of approved rider education courses. Gives both novice and experienced riders the option of taking a course that is specific to their needs and allows waiver of some or all tests. 3) Require both knowledge and skills test to obtain endorsement. Ensures applicants possess basic skill and knowledge required to operate a motorcycle.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

1) Dedicated funding for rider education. Oregon collects $56 from every motorcycle endorsement issuance (original and renewal) to support Motorcycle Safety Training. Allows for a steady state funding source to administer the program. 2) Integrated rider education and licensing. Students can take certain training completion cards to DMV and have their endorsement added without further testing. 3) Governor's Advisory Committee on Motorcycle Safety provides regular, ongoing stakeholder input into the planning process, identifies problems, promotes initiatives and provides input for legislative concepts.

Please provide your name, title, address, telephone, and email.

Name: **Michele O'Leary**

Title: **Motorcycle Safety Program Manager**

Address: **235 Union St. NE**
Salem, OR 97301

Telephone: **503-986-4198**

Email: **michele.a.oleary@odot.state.or.us**

May we contact you if we have additional questions or need to clarify your responses? **Yes**

Would you like a copy of the results of our study? **Yes**

25. Carol Thurn
Program Manager
608 E Boulevard Ave
Bismarck, ND 58505

I. CHANGES TO POLICIES AND PRACTICES

1. Has your agency made any changes to its Motorcycle Safety Program in the last 5 years? What changes were made and why?

We changed the way we do our Quality Assurance. We made the changes to make sure we cover all aspects of the program.

2. Is your agency considering or planning any changes to its Motorcycle Safety Program in the foreseeable future directed toward safer motorcycle drivers and crash prevention? If so, please describe.

We are working on Share the Road media campaigns. We are also working with our military to make sure they are properly trained especially after they return home from serving overseas.

II. RESEARCH AND EVALUATION

3. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle rider education program(s)* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e.should be available)**

4. Has your agency sponsored or performed any studies/research that examine the effectiveness of its *motorcycle licensing practices* in contributing to safer motorcycle drivers or preventing crashes that result in death or injury?

No

If 'Yes' and a report is available electronically, please provide a website address:

If a report is available only in hardcopy, please mail it to the address below.
If no report is available, please check here: **No (i.e. should be available)**

III. BEST PRACTICES SUMMARY

5. What are the top three *motorcycle rider education practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

Education is important to our motorcycle riders. We continue to train people. Our fatality numbers are less than 10 per year so it is hard to say what to do differently to reduce the numbers.

6. What are the top three *motorcycle licensing practices* used by your agency that contribute to safer motorcycle drivers or result in a decrease in crashes resulting in death and injury? Why are these effective?

If an individual does not take the education training they can go through the licensing process. There usually is no wait time for getting tested through the licensing system. The certified driver license examiners are required to go through the motorcycle training course.

7. What are the top three *program administration practices* that contribute to safer motorcycle drivers in your state or result in a decrease in crashes resulting in death and injury? Why are these effective?
(Program administration includes elements such as integrated rider education and licensing, dedicated funding for rider education, and a system to record rider education, licensing, and crash data.)

We work very closely with our contractor that administers the training classes. We also work closely with SMSA and MSF.

Please provide your name, title, address, telephone, and email.

Name: **Carol Thurn**
Title: **Program Manager**
Address: **608 E Boulevard Ave**
Bismarck, ND 58505
Telephone: **701-328-4354**
Email: **cthurn@nd.gov**

May we contact you if we have additional questions or need to clarify your responses?	**Yes**
Would you like a copy of the results of our study?	**Yes**

Appendix B: Frequency Distributions for Crash Record Variables

Table B1. Motorcycle Driver Injury Severity

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
Not Injured	2,233	8.9	432	9.3	1,071	8.9	688	9.1
Minor Injury	9,058	36.1	1,729	37.2	4,320	35.8	2,725	35.9
Moderate Injury	9,016	35.9	1,602	34.4	4,275	35.5	2,810	37.0
Major Injury	3,541	14.1	602	12.9	1,784	14.8	1,040	13.7
Killed	1,263	5.0	289	6.2	604	5.0	335	4.4
Total	25,111	100.0	4,654	100.0	12,054	100.0	7,598	100.0
Missing Value	2,651		475		1,162		925	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B2. Motorcycle Driver Fatality

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	23,848	95.0	4,365	93.8	11,450	95.0	7,263	95.6
Yes	1,263	5.0	289	6.2	604	5.0	335	4.4
Total	25,111	100.0	4,654	100.0	12,054	100.0	7,598	100.0
Missing Value	2,651		475		1,162		925	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B3. Motorcycle Driver at Fault

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	8,233	29.7	1,252	24.4	4,409	33.4	2,333	27.4
Yes	19,529	70.3	3,877	75.6	8,807	66.6	6,190	72.6
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B4. Motorcycle Driver DUI at time of crash

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	26,315	94.8	4,986	97.2	12,254	92.7	8,219	96.4
Yes	1,447	5.2	143	2.8	962	7.3	304	3.6
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B5. Motorcycle Driver Speeding at time of Crash

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	22,505	81.1	3,813	74.3	11,229	85.0	6,692	78.5
Yes	5,255	18.9	1,316	25.7	1,986	15.0	1,830	21.5
Total	27,760	100.0	5,129	100.0	13,215	100.0	8,522	100.0

Table B6. Motorcycle Driver Over/Under Compensating at Curve

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	24,962	89.9	4,526	88.2	11,892	90.0	7,714	90.5
Yes	2,798	10.1	603	11.8	1,323	10.0	808	9.5
Total	27,760	100.0	5,129	100.0	13,215	100.0	8,522	100.0

Table B7. Motorcycle Driver Inexperienced

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	26,039	93.8	4,754	92.7	12,758	96.5	7,703	90.4
Yes	1,721	6.2	375	7.3	457	3.5	819	9.6
Total	27,760	100.0	5,129	100.0	13,215	100.0	8,522	100.0

Table B8. Motorcycle Driver Affected by Physical Condition

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	26,195	94.4	4,926	96.0	12,158	92.0	8,260	96.9
Yes	1,565	5.6	203	4.0	1,057	8.0	262	3.1
Total	27,760	100.0	5,129	100.0	13,215	100.0	8,522	100.0

Table B9. Motorcycle Driver Improper Driving

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	21,682	78.1	3,987	77.7	10,444	79.0	6,600	77.4
Yes	6,078	21.9	1,142	22.3	2,771	21.0	1,922	22.6
Total	27,760	100.0	5,129	100.0	13,215	100.0	8,522	100.0

Table B10. Motorcycle Driver Other Improper Driving

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	24,495	88.2	4,439	86.5	11,871	89.8	7,424	87.1
Yes	3,265	11.8	690	13.5	1,344	10.2	1,098	12.9
Total	27,760	100.0	5,129	100.0	13,215	100.0	8,522	100.0

Table B11. Motorcycle Driver had Passenger

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	21,412	86.7	4,796	93.8	10,194	82.8	5,714	88.2
Yes	3,276	13.3	315	6.2	2,118	17.2	763	11.8
Total	24,688	100.0	5,111	100.0	12,312	100.0	6,477	100.0
Missing Value	3,074		18		904		2,046	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B12. Motorcycle Driver Wearing Helmet

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	7,105	28.3	954	21.1	3,625	30.3	2,243	28.7
Yes	18,008	71.7	3,571	78.9	8,339	69.7	5,570	71.3
Total	25,113	100.0	4,525	100.0	11,964	100.0	7,813	100.0
Missing Value	2,649		604		1,252		710	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B13. Motorcycle Driver MBAC ever

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	2,993	10.8	627	12.2	772	5.8	1,341	15.7
Yes	24,769	89.2	4,502	87.8	12,444	94.2	7,182	84.3
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B14. Single / Multiple Vehicle Crash

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
Single Vehicle	13,025	46.9	2,550	49.7	6,190	46.8	3,891	45.7
Multiple Vehicle	14,737	53.1	2,579	50.3	7,026	53.2	4,632	54.3
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B15. Motorcycle Type Code

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
Sport/Street	5,129	18.5	5,129	100.0				
Cruiser	13,216	47.6			13,216	100.0		
Dual Sport	425	1.5						
Off-road	156	0.6						
Scooter/Moped	312	1.1						
Minibike	1	0.0						
Unknown	8,523	30.7					8,523	100.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B16. Any Adverse Environmental Condition

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
No	23,719	86.4	4,538	89.3	11,178	85.4	7,258	86.4
Yes	3,730	13.6	542	10.7	1,916	14.6	1,138	13.6
Total	27,449	100.0	5,080	100.0	13,094	100.0	8,396	100.0
Missing Value	313		49		122		127	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B17. Urban or Rural Crash Location

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
Rural	9,750	38.7	1,692	33.5	5,368	43.5	2,337	33.5
Urban	15,443	61.3	3,366	66.5	6,974	56.5	4,638	66.5
Total	25,193	100.0	5,058	100.0	12,342	100.0	6,975	100.0
Missing Value	2,569		71		874		1,548	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B18. License class from crash records on day of crash

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
	540	1.9	67	1.3	74	0.6	344	4.0
?	2	0.0					2	0.0
??	2	0.0			1	0.0	1	0.0
0	5	0.0			4	0.0		
00	2	0.0			2	0.0		
01	1	0.0			1	0.0		
06	1	0.0			1	0.0		
2	2	0.0	1	0.0			1	0.0
50	1	0.0	1	0.0				
6	3	0.0			1	0.0	2	0.0
61	1	0.0					1	0.0
62	1	0.0			1	0.0		
9	13,318	48.0	3,185	62.1	7,401	56.0	2,343	27.5
A	1	0.0			1	0.0		
A *	394	1.4	31	0.6	187	1.4	167	2.0
A/M	2	0.0	1	0.0	1	0.0		
AM	4	0.0			2	0.0	2	0.0
AM*	1,011	3.6	61	1.2	651	4.9	279	3.3
AMâ	2	0.0			1	0.0	1	0.0
B	1	0.0			1	0.0		
B *	165	0.6	24	0.5	60	0.5	74	0.9
BM	4	0.0			3	0.0	1	0.0
BM*	411	1.5	20	0.4	244	1.8	134	1.6
C-M	1	0.0					1	0.0
C	5,077	18.3	1,036	20.2	1,220	9.2	2,582	30.3
C *	4	0.0			3	0.0	1	0.0
C â	31	0.1	2	0.0	7	0.1	20	0.2
C,M	3	0.0	1	0.0	1	0.0	1	0.0
C,P	1	0.0	1	0.0				
CM	6,672	24.0	693	13.5	3,293	24.9	2,529	29.7
CM*	16	0.1	2	0.0	10	0.1	4	0.0
CMâ	66	0.2	3	0.1	41	0.3	21	0.2
JR	1	0.0					1	0.0
M	15	0.1			4	0.0	10	0.1
MC	1	0.0					1	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B19. Total Number Motorcycle Crashes

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
1	23,400	84.3	4,601	89.7	10,567	80.0	7,436	87.2
2	4,055	14.6	482	9.4	2,467	18.7	1,017	11.9
3	236	0.9	36	0.7	141	1.1	52	0.6
4	60	0.2	8	0.2	34	0.3	16	0.2
5	10	0.0	1	0.0	7	0.1	2	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B20. Crashes Before/After Helmet Law Repeal

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
Before Repeal Date	15,451	55.7	2,861	55.8	7,839	59.3	4,281	50.2
After Repeal Date	12,311	44.3	2,268	44.2	5,377	40.7	4,242	49.8
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B21. Year of Crash

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
1997	2,169	7.8	421	8.2	1,258	9.5	419	4.9
1998	2,332	8.4	450	8.8	1,372	10.4	429	5.0
1999	2,375	8.6	597	11.6	1,315	10.0	401	4.7
2000	2,469	8.9	621	12.1	1,339	10.1	441	5.2
2001	2,357	8.5	360	7.0	1,062	8.0	864	10.1
2002	2,228	8.0	191	3.7	875	6.6	1,089	12.8
2003	2,058	7.4	296	5.8	866	6.6	839	9.8
2004	2,544	9.2	423	8.2	1,108	8.4	936	11.0
2005	2,924	10.5	490	9.6	1,268	9.6	1,064	12.5
2006	3,030	10.9	630	12.3	1,301	9.8	991	11.6
2007	3,276	11.8	650	12.7	1,452	11.0	1,050	12.3
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B22. Unit Number

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
1	19,529	70.3	3,877	75.6	8,807	66.6	6,190	72.6
2	7,871	28.4	1,206	23.5	4,197	31.8	2,234	26.2
3	309	1.1	39	0.8	180	1.4	85	1.0
4	44	0.2	5	0.1	26	0.2	13	0.2
5	6	0.0	1	0.0	5	0.0		
6	2	0.0	1	0.0	1	0.0		
7	1	0.0					1	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B23. Number of Fatalities

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	26,373	95.0	4,816	93.9	12,539	94.9	8,163	95.8
1	1,339	4.8	305	5.9	646	4.9	351	4.1
2	48	0.2	7	0.1	31	0.2	8	0.1
3	1	0.0					1	0.0
5	1	0.0	1	0.0				
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B24. Number of Persons Injured

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	2,349	8.5	568	11.1	1,000	7.6	729	8.6
1	21,445	77.2	4,032	78.6	9,911	75.0	6,761	79.3
2	3,448	12.4	446	8.7	1,996	15.1	920	10.8
3	375	1.4	61	1.2	220	1.7	83	1.0
4	100	0.4	12	0.2	61	0.5	23	0.3
5 or more	45	0.2	10	0.2	28	0.1	7	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B25. Total Units involved in Crash

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
1	13,025	46.9	2,550	49.7	6,190	46.8	3,891	45.7
2	13,476	48.5	2,348	45.8	6,422	48.6	4,231	49.6
3	1,033	3.7	196	3.8	476	3.6	338	4.0
4	176	0.6	25	0.5	98	0.7	52	0.6
5	32	0.1	5	0.1	20	0.2	6	0.1
6	16	0.1	5	0.1	9	0.1	2	0.0
7	3	0.0			1	0.0	2	0.0
9	1	0.0					1	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B26. 1st roadway-environmental factor

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
None	23,764	86.6	4,542	89.4	11,190	85.5	7,287	86.8
01 - Windy conditions	76	0.3	16	0.3	28	0.2	28	0.3
02 - Sudden weather conditions	38	0.1	1	0.0	20	0.2	16	0.2
03 - Other weather conditions	96	0.3	14	0.3	43	0.3	38	0.5
04 - Deer in roadway	1,217	4.4	145	2.9	713	5.4	315	3.8
05 - Obstacle in roadway	261	1.0	47	0.9	124	0.9	87	1.0
06 - Other animal in roadway	415	1.5	74	1.5	214	1.6	107	1.3
07 - Glare	119	0.4	19	0.4	64	0.5	29	0.3
08 - Work zone related	56	0.2	8	0.2	20	0.2	27	0.3
11 - Slippery road condition (ice/snow)	75	0.3	6	0.1	41	0.3	24	0.3
12 - Substances in roadway	597	2.2	96	1.9	306	2.3	178	2.1
13 - Potholes	102	0.4	20	0.4	35	0.3	42	0.5
14 - Broken or cracked pavement	80	0.3	20	0.4	35	0.3	23	0.3
15 - TCD Obstructed	3	0.0			2	0.0	1	0.0
16 - Soft shoulder or shoulder drop off	77	0.3	7	0.1	42	0.3	25	0.3
28 - Other roadway factor	431	1.6	62	1.2	198	1.5	151	1.8
29 - Other environmental factor	42	0.2	3	0.1	19	0.1	18	0.2
Total	27,449	100.0	5,080	100.0	13,094	100.0	8,396	100.0
Missing Value	313		49		122		127	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B27. 2nd roadway-environmental factor

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
None	27,551	99.2	5,110	99.6	13,117	99.3	8,440	99.0
01 - Windy conditions	16	0.1	1	0.0	4	0.0	10	0.1
02 - Sudden weather conditions	6	0.0	1	0.0	3	0.0	2	0.0
03 - Other weather conditions	7	0.0			3	0.0	4	0.0
04 - Deer in roadway	16	0.1	2	0.0	8	0.1	6	0.1
05 - Obstacle in roadway	7	0.0			3	0.0	4	0.0
06 - Other animal in roadway	9	0.0	2	0.0	1	0.0	6	0.1
07 - Glare	5	0.0			3	0.0	1	0.0
08 - Work zone related	9	0.0	1	0.0	7	0.1	1	0.0
11 - Slippery road condition (ice/snow)	8	0.0	2	0.0	4	0.0	2	0.0
12 - Substances in roadway	28	0.1	3	0.1	13	0.1	10	0.1
13 - Potholes	12	0.0	1	0.0	2	0.0	8	0.1
14 - Broken or cracked pavement	21	0.1			10	0.1	8	0.1
16 - Soft shoulder or shoulder drop off	16	0.1			11	0.1	5	0.1
28 - Other roadway factor	43	0.2	6	0.1	23	0.2	12	0.1
29 - Other environmental factor	8	0.0			4	0.0	4	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B28. 3rd roadway-environmental factor

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
None	27,732	99.9	5,124	99.9	13,203	99.9	8,512	99.9
Other	30	0.1	5	0.1	12	0.1	11	0.1
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B29. Prime Factor Source Code Converted

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
Driver	24,439	88.0	4,630	90.3	11,461	86.7	7,573	88.9
Environment/Roadway	2,751	9.9	399	7.8	1,513	11.4	742	8.7
Pedestrian	104	0.4	15	0.3	44	0.3	36	0.4
Vehicle	468	1.7	85	1.7	198	1.5	172	2.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B30. Prime Factor Combined

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No contributing action	4	0.0			1	0.0	3	0.0
Driver was distracted	618	2.2	78	1.5	289	2.2	226	2.7
Driving using hand-held phone	32	0.1	2	0.0	14	0.1	15	0.2
Driving using hands-free phone	1	0.0					1	0.0
Making illegal U-turn	238	0.9	54	1.1	91	0.7	87	1.0
Making improper or careless turn	2,892	10.4	421	8.2	1,477	11.2	894	10.5
Turning from wrong lane	132	0.5	25	0.5	68	0.5	37	0.4
Proceeding w/o clearance after stop	1,853	6.7	316	6.2	1,025	7.8	464	5.4
Running stop sign	407	1.5	63	1.2	182	1.4	137	1.6
Running red light	348	1.3	67	1.3	161	1.2	108	1.3
Failure to respond to TCD	74	0.3	9	0.2	37	0.3	22	0.3
Tailgating	1,111	4.0	226	4.4	606	4.6	266	3.1
Sudden slowing or stopping	439	1.6	54	1.1	201	1.5	171	2.0
Illegally stopped on road	26	0.1	5	0.1	12	0.1	8	0.1
Careless passing or lane change	1,178	4.2	270	5.3	525	4.0	346	4.1
Passing in no passing zone	152	0.5	29	0.6	74	0.6	47	0.6
Driving the wrong way on 1-way street	38	0.1	3	0.1	13	0.1	18	0.2
Careless or illegal backing on roadway	108	0.4	21	0.4	59	0.4	25	0.3
Driving on the wrong side of roadway	901	3.2	171	3.3	455	3.4	222	2.6
Making improper entrance to highway	954	3.4	174	3.4	498	3.8	246	2.9
Making improper exit from highway	467	1.7	103	2.0	272	2.1	83	1.0
Careless parking or unparking	73	0.3	13	0.3	29	0.2	25	0.3
Over or under compensation at curve	1,899	6.8	381	7.4	929	7.0	548	6.4
Speeding	1,244	4.5	396	7.7	323	2.4	502	5.9
Driving too fast for conditions	2,779	10.0	609	11.9	1,213	9.2	880	10.3
Failure to maintain proper speed	166	0.6	23	0.4	67	0.5	72	0.8
Driver fleeing police (police chase)	128	0.5	42	0.8	23	0.2	53	0.6
Driver inexperienced	841	3.0	164	3.2	244	1.8	394	4.6
Failure to use specialized equipment	66	0.2	13	0.3	29	0.2	22	0.3
Affected by physical condition	298	1.1	36	0.7	193	1.5	62	0.7
Other improper driving actions	4,297	15.5	807	15.7	2,136	16.2	1,206	14.2
Unknown driver action	675	2.4	55	1.1	215	1.6	383	4.5
Windy conditions	25	0.1	5	0.1	12	0.1	7	0.1
Sudden weather conditions	17	0.1			9	0.1	8	0.1
Other weather conditions	24	0.1	5	0.1	10	0.1	9	0.1
Deer in roadway	1,177	4.2	141	2.7	696	5.3	299	3.5
Obstacle on roadway	206	0.7	35	0.7	101	0.8	68	0.8
Other animal in roadway	358	1.3	61	1.2	189	1.4	91	1.1
Glare	25	0.1	2	0.0	17	0.1	3	0.0
Work zone related	17	0.1	1	0.0	9	0.1	7	0.1
Slippery road conditions (ice/snow)	41	0.1	5	0.1	25	0.2	10	0.1
Substances on roadway	412	1.5	65	1.3	226	1.7	109	1.3
Potholes	77	0.3	15	0.3	26	0.2	34	0.4
Broken or cracked pavement	51	0.2	14	0.3	25	0.2	11	0.1
TCD obstructed	2	0.0			1	0.0	1	0.0
Soft shoulder or shoulder drop off	20	0.1	1	0.0	12	0.1	6	0.1
Other roadway factor	185	0.7	23	0.4	92	0.7	59	0.7
Other environmental factor	98	0.4	24	0.5	56	0.4	15	0.2
Unknown environmental road factor	14	0.1	2	0.0	6	0.0	4	0.0
Entering or crossing at specified location	67	0.2	13	0.3	27	0.2	21	0.2
Walking, running, jogging, playing or cycling	21	0.1			11	0.1	8	0.1
Approaching or leaving vehicle	1	0.0					1	0.0
Standing	3	0.0	1	0.0			2	0.0
Other pedestrian action	10	0.0	1	0.0	5	0.0	3	0.0
Unknown pedestrian action	2	0.0					1	0.0
No vehicle failure	1	0.0			1	0.0	1	0.0
Tires	116	0.4	25	0.5	51	0.4	34	0.4
Brake system	106	0.4	21	0.4	51	0.4	33	0.4
Steering system	38	0.1	7	0.1	14	0.1	17	0.2
Suspension	4	0.0	1	0.0	2	0.0		
Power train	82	0.3	19	0.4	33	0.2	30	0.4
Exhaust	1	0.0			1	0.0		
Headlights	8	0.0	1	0.0	2	0.0	2	0.0
Signal lights	2	0.0	1	0.0			1	0.0
Other lights	2	0.0	1	0.0	2	0.0		
Driver seating/control	4	0.0					3	0.0
Body/doors/hood/etc	6	0.0			5	0.0	1	0.0
Wheels	20	0.1	4	0.1	6	0.0	10	0.1
Unsecured or shifted trailer load	13	0.0	3	0.1	7	0.1	3	0.0
Improper towing	3	0.0	1	0.0	2	0.0		
Obstructed windshield	1	0.0			1	0.0		
Unknown vehicle failure	60	0.2	1	0.0	20	0.2	37	0.4
Total	27,760	100.0	5,129	100.0	13,215	100.0	8,522	100.0

Table B31. Most Harmful Event

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
Hit unit 1	3,450	12.4	581	11.3	1,877	14.2	907	10.6
Hit unit 2	8,513	30.7	1,628	31.7	4,020	30.4	2,542	29.8
Hit unit 3	157	0.6	19	0.4	93	0.7	42	0.5
Hit unit 4	15	0.1			11	0.1	4	0.0
Hit unit 5	2	0.0			2	0.0		
Hit other traffic unit	1	0.0					1	0.0
Hit deer	984	3.5	112	2.2	579	4.4	254	3.0
Hit other animal	199	0.7	28	0.5	108	0.8	51	0.6
Hit other non-fixed object	56	0.2	6	0.1	20	0.2	29	0.3
Struck by unit 1	795	2.9	59	1.2	253	1.9	448	5.3
Struck by unit 2	541	1.9	73	1.4	231	1.7	212	2.5
Struck by unit 3	9	0.0			5	0.0	4	0.0
Struck by unit 4	1	0.0					1	0.0
Hit tree or shrubbery	537	1.9	118	2.3	244	1.8	153	1.8
Hit embankment	735	2.6	136	2.7	363	2.7	220	2.6
Hit utility pole	400	1.4	85	1.7	192	1.5	117	1.4
Hit traffic sign	155	0.6	31	0.6	77	0.6	42	0.5
Hit guide rail	906	3.3	180	3.5	405	3.1	302	3.5
Hit guide rail end	30	0.1	5	0.1	18	0.1	7	0.1
Hit curb	452	1.6	91	1.8	177	1.3	167	2.0
Hit concrete or longitudinal barrier	256	0.9	65	1.3	85	0.6	104	1.2
Hit ditch	429	1.5	67	1.3	217	1.6	129	1.5
Hit fence or wall	293	1.1	58	1.1	137	1.0	90	1.1
Hit building	71	0.3	16	0.3	25	0.2	24	0.3
Hit culvert	87	0.3	14	0.3	36	0.3	31	0.4
Hit bridge pier or abutment	15	0.1	4	0.1	7	0.1	3	0.0
Hit parapet end	4	0.0			3	0.0	1	0.0
Hit bridge rail	31	0.1	5	0.1	17	0.1	9	0.1
Hit boulder or obstacle in roadway	165	0.6	34	0.7	72	0.5	56	0.7
Hit impact attenuator or crash cushion	1	0.0			1	0.0		
Hit fire hydrant	13	0.0	6	0.1	5	0.0	2	0.0
Hit roadway equipment	3	0.0			1	0.0	2	0.0
Hit mail box	108	0.4	31	0.6	43	0.3	33	0.4
Hit traffic island or channelization	43	0.2	7	0.1	24	0.2	11	0.1
Hit snow bank	1	0.0			1	0.0		
Hit temporary construction barrier	12	0.0	2	0.0	6	0.0	4	0.0
Hit other fixed object	400	1.4	72	1.4	175	1.3	140	1.6
Hit unknown fixed object	27	0.1	6	0.1	12	0.1	8	0.1
Overturn or roll over	941	3.4	182	3.5	450	3.4	282	3.3
Struck by thrown or falling object	34	0.1	5	0.1	21	0.2	8	0.1
Pothole or other pavement irregularities	159	0.6	13	0.3	57	0.4	78	0.9
Jackknife	3	0.0	1	0.0	2	0.0		
Fire in vehicle	22	0.1	6	0.1	9	0.1	7	0.1
Other non-collision	6,543	23.6	1,359	26.5	3,075	23.3	1,929	22.6
Unknown what was hit	156	0.6	24	0.5	59	0.4	63	0.7
Total	27,755	100.0	5,129	100.0	13,215	100.0	8,517	100.0

Table B32. Most Harmful Event Unit Number

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
1	22,829	82.3	4,408	85.9	10,734	81.3	6,931	81.4
2	4,857	17.5	711	13.9	2,451	18.6	1,560	18.3
3	53	0.2	10	0.2	19	0.1	21	0.2
4	7	0.0			5	0.0	2	0.0
5	3	0.0			2	0.0	1	0.0
7	1	0.0					1	0.0
Total	27,750	100.0	5,129	100.0	13,211	100.0	8,516	100.0

Table B33. Intersection Type

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
00 - Mid-block	17,551	63.2	3,377	65.8	8,269	62.6	5,344	62.7
01 - Four-way intersection	4,860	17.5	804	15.7	2,307	17.5	1,579	18.5
02 - T intersection	4,318	15.6	777	15.1	2,138	16.2	1,266	14.9
03 - Y intersection	472	1.7	82	1.6	241	1.8	139	1.6
04 - Traffic circle or roundabout	21	0.1	2	0.0	14	0.1	4	0.0
05 - Multi-leg intersection	141	0.5	21	0.4	60	0.5	56	0.7
06 - On ramp	160	0.6	27	0.5	78	0.6	53	0.6
07 - Off ramp	132	0.5	25	0.5	66	0.5	37	0.4
08 - Crossover	7	0.0			1	0.0	5	0.1
09 - Railroad crossing	14	0.1	1	0.0	9	0.1	4	0.0
10 - Other	82	0.3	11	0.2	32	0.2	35	0.4
99 - Unknown (expired)	4	0.0	2	0.0	1	0.0	1	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B34. Illumination

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
1 - Daylight	19,608	70.6	3,640	71.0	9,317	70.5	5,985	70.2
2 - Dark - no street lights	3,336	12.0	536	10.5	1,826	13.8	880	10.3
3 - Dark - street lights	3,576	12.9	714	13.9	1,523	11.5	1,247	14.6
4 - Dusk	893	3.2	179	3.5	392	3.0	290	3.4
5 - Dawn	203	0.7	34	0.7	97	0.7	66	0.8
6 - Dark - unknown roadway lighting	76	0.3	6	0.1	27	0.2	40	0.5
8 - Other	12	0.0	2	0.0	2	0.0	8	0.1
9 - Unknown (expired)	58	0.2	18	0.4	32	0.2	7	0.1
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B35. Roadway Surface Type

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
1 - Concrete	85	6.1	27	8.6	35	5.1	22	6.1
2 - Blacktop	1,123	80.5	242	77.3	581	85.3	276	76.2
3 - Brick or block	3	0.2			1	0.1	1	0.3
4 - Slag, gravel, or stone	1	0.1					1	0.3
5 - Dirt	4	0.3					3	0.8
8 - Other	7	0.5	1	0.3	3	0.4	3	0.8
9 - Unknown	172	12.3	43	13.7	61	9.0	56	15.5
Total	1,395	100.0	313	100.0	681	100.0	362	100.0
Missing Value	26,367		4,816		12,535		8,161	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B36. Roadway Surface Condition

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0 - Dry	26,165	94.2	4,943	96.4	12,408	93.9	7,994	93.8
1 - Wet	1,158	4.2	123	2.4	615	4.7	379	4.4
2 - Sand/mud/dirt/oil/gravel	173	0.6	20	0.4	66	0.5	71	0.8
3 - Snow covered	6	0.0			2	0.0	3	0.0
4 - Slush	1	0.0					1	0.0
5 - Ice	7	0.0	1	0.0	4	0.0	1	0.0
6 - Ice patches	24	0.1	4	0.1	13	0.1	6	0.1
7 - Water - standing or moving	7	0.0	1	0.0	3	0.0	2	0.0
8 - Other	125	0.5	12	0.2	53	0.4	49	0.6
9 - Unknown (expired)	96	0.3	25	0.5	52	0.4	17	0.2
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B37. Crash relative to roadway

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
1 - On roadway	21,209	76.4	3,922	76.5	10,212	77.3	6,373	74.8
2 - Shoulder	2,277	8.2	387	7.5	996	7.5	830	9.7
3 - Median	216	0.8	35	0.7	98	0.7	79	0.9
4 - Roadside (off trafficway or vehicle area)	1,175	4.2	185	3.6	501	3.8	454	5.3
5 - Outside trafficway (in area not meant for vehic	2,711	9.8	585	11.4	1,361	10.3	685	8.0
6 - In parking lane	72	0.3	7	0.1	8	0.1	53	0.6
7 - Gore (intersection of ramp and highway)	45	0.2	3	0.1	17	0.1	23	0.3
9 - Unknown	57	0.2	5	0.1	23	0.2	26	0.3
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B38. Driver Gender

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
Female	1,422	5.1	142	2.8	737	5.6	445	5.2
Male	26,313	94.8	4,982	97.1	12,471	94.4	8,066	94.6
Unknown	27	0.1	5	0.1	8	0.1	12	0.1
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B39. Motorcycle Passenger

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
	3	0.0					3	0.0
No	21,412	77.1	4,796	93.5	10,194	77.1	5,714	67.0
Unknown	3,071	11.1	18	0.4	904	6.8	2,043	24.0
Yes	3,276	11.8	315	6.1	2,118	16.0	763	9.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B40. Driver Helmet Recoded

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	1,375	21.2	193	12.1	680	25.2	440	22.4
Yes	5,117	78.8	1,401	87.9	2,014	74.8	1,525	77.6
Total	6,492	100.0	1,594	100.0	2,694	100.0	1,965	100.0
Missing Value	21,270		3,535		10,522		6,558	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B41. Motorcycle Make

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
34 - BMW	300	1.1	64	1.2	49	0.4	159	2.1
37 - Honda	5,654	21.2	1,244	24.3	1,918	14.5	2,196	29.5
50 - Triumph	256	1.0	99	1.9	65	0.5	92	1.2
53 - Suzuki	4,531	17.0	1,707	33.3	757	5.7	1,840	24.8
72 - Harley	8,636	32.4			8,632	65.3		
73 - Kawasaki	3,553	13.3	1,033	20.2	639	4.8	1,761	23.7
76 - Yamaha	3,718	14.0	976	19.1	1,154	8.7	1,385	18.6
Total	26,648	100.0	5,123	100.0	13,214	100.0	7,433	100.0
Missing Value	1,114		6		2		1,090	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B42. Motorcycle Body Type

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
Motorcycle	26,038	93.8	5,014	97.8	12,993	98.3	7,732	90.7
Moped	76	0.3	1	0.0	1	0.0	45	0.5
Three-wheeled motorcycle or moped	28	0.1	1	0.0	11	0.1	14	0.2
Off-road motorcycle	307	1.1						
ATV	27	0.1					13	0.2
Mini-bike or motor scooter	167	0.6						
Other motorcycle type	114	0.4	4	0.1	2	0.0	46	0.5
Unknown motorcycle type	1,004	3.6	109	2.1	209	1.6	672	7.9
Total	27,761	100.0	5,129	100.0	13,216	100.0	8,522	100.0

Table B43. Collision Description

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
Non-collision	7,457	26.9	1,520	29.6	3,470	26.3	2,252	26.4
Rear-end	3,283	11.8	573	11.2	1,628	12.3	992	11.6
Head-on	1,049	3.8	151	2.9	450	3.4	396	4.6
Backing	52	0.2	12	0.2	25	0.2	13	0.2
Angle	7,114	25.6	1,256	24.5	3,510	26.6	2,102	24.7
Sideswipe (same direction)	1,078	3.9	201	3.9	477	3.6	368	4.3
Sideswipe (opposite direction)	472	1.7	55	1.1	204	1.5	191	2.2
Hit fixed object	5,350	19.3	1,085	21.2	2,465	18.7	1,652	19.4
Hit pedestrian	148	0.5	25	0.5	55	0.4	54	0.6
Other or unknown	1,759	6.3	251	4.9	932	7.1	503	5.9
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B44. Driver Action #1

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
00 - No contributing action	11,214	40.4	1,778	34.7	5,999	45.4	3,107	36.5
01 - Driver was distracted	457	1.6	61	1.2	225	1.7	160	1.9
02 - Driving using hand-held phone	11	0.0	1	0.0	5	0.0	4	0.0
03 - Driving using hands-free phone	2	0.0			1	0.0		
04 - Making illegal U-turn	41	0.1	6	0.1	15	0.1	19	0.2
05 - Making improper or careless turn	620	2.2	93	1.8	302	2.3	190	2.2
06 - Turning from wrong lane	20	0.1	3	0.1	8	0.1	9	0.1
07 - Proceeding w/o clearance after stop	142	0.5	17	0.3	73	0.6	41	0.5
08 - Running stop sign	159	0.6	23	0.4	48	0.4	68	0.8
09 - Running red light	187	0.7	44	0.9	77	0.6	59	0.7
10 - Failure to respond to TCD	46	0.2	5	0.1	20	0.2	16	0.2
11 - Tailgating	772	2.8	161	3.1	422	3.2	180	2.1
12 - Sudden slowing or stopping	504	1.8	63	1.2	236	1.8	191	2.2
13 - Illegally stopped on road	7	0.0	1	0.0	4	0.0	2	0.0
14 - Careless passing or lane change	783	2.8	189	3.7	332	2.5	235	2.8
15 - Passing in no passing zone	143	0.5	33	0.6	68	0.5	41	0.5
16 - Driving wrong way on 1-way street	29	0.1	1	0.0	7	0.1	18	0.2
17 - Careless or illegal backing on roadway	6	0.0			3	0.0	2	0.0
18 - Driving on the wrong side of roadway	618	2.2	131	2.6	297	2.2	155	1.8
19 - Making improper entrance to highway	178	0.6	23	0.4	63	0.5	74	0.9
20 - Making improper exit from highway	72	0.3	20	0.4	34	0.3	15	0.2
21 - Careless parking or unparking	17	0.1	3	0.1	8	0.1	5	0.1
22 - Over or under compensation at curve	2,007	7.2	400	7.8	988	7.5	573	6.7
23 - Speeding	1,359	4.9	428	8.3	358	2.7	545	6.4
24 - Driving too fast for conditions	2,714	9.8	629	12.3	1,154	8.7	862	10.1
25 - Failure to maintain proper speed	160	0.6	26	0.5	59	0.4	72	0.8
26 - Driver fleeing police (police chase)	128	0.5	42	0.8	19	0.1	55	0.6
27 - Driver inexperienced	898	3.2	178	3.5	256	1.9	422	5.0
28 - Failure to use specialized equipment	9	0.0	2	0.0	1	0.0	5	0.1
92 - Affected by physical condition	1,043	3.8	114	2.2	730	5.5	169	2.0
98 - Other improper driving actions	2,712	9.8	589	11.5	1,169	8.8	852	10.0
99 - Unknown	702	2.5	65	1.3	234	1.8	376	4.4
Total	27,760	100.0	5,129	100.0	13,215	100.0	8,522	100.0

Table B45. Driver Action #2

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
00 - No contributing action	247	5.5	32	3.4	97	5.3	111	7.0
01 - Driver was distracted	90	2.0	17	1.8	44	2.4	27	1.7
02 - Driving using hand-held phone	3	0.1	1	0.1	1	0.1	2	0.1
03 - Driving using hands-free phone	1	0.0					1	0.1
04 - Making illegal U-turn	2	0.0					1	0.1
05 - Making improper or careless turn	79	1.8	10	1.1	41	2.2	25	1.6
06 - Turning from wrong lane	6	0.1	1	0.1	4	0.2	1	0.1
07 - Proceeding w/o clearance after stop	7	0.2	1	0.1	5	0.3	1	0.1
08 - Running stop sign	27	0.6	7	0.7	7	0.4	11	0.7
09 - Running red light	23	0.5	4	0.4	6	0.3	12	0.8
10 - Failure to respond to TCD	15	0.3	2	0.2	9	0.5	4	0.3
11 - Tailgating	90	2.0	13	1.4	54	2.9	22	1.4
12 - Sudden slowing or stopping	109	2.4	20	2.1	46	2.5	39	2.5
14 - Careless passing or lane change	119	2.6	31	3.3	48	2.6	37	2.3
15 - Passing in no passing zone	42	0.9	3	0.3	18	1.0	20	1.3
16 - Driving wrong way on 1-way street	2	0.0	69	7.3	1	0.1	1	0.1
17 - Careless or illegal backing on roadway	2	0.0					2	0.1
18 - Driving on the wrong side of roadway	310	6.9	2	0.2	168	9.2	65	4.1
19 - Making improper entrance to highway	28	0.6			7	0.4	15	1.0
20 - Making improper exit from highway	28	0.6	7	0.7	10	0.5	10	0.6
21 - Careless parking or unparking	3	0.1			1	0.1	2	0.1
22 - Over or under compensation at curve	623	13.9	154	16.2	276	15.0	182	11.5
23 - Speeding	404	9.0	114	12.0	122	6.6	158	10.0
24 - Driving too fast for conditions	786	17.5	171	18.0	312	17.0	283	18.0
25 - Failure to maintain proper speed	87	1.9	13	1.4	29	1.6	43	2.7
26 - Driver fleeing police (police chase)	40	0.9	13	1.4	15	0.8	10	0.6
27 - Driver inexperienced	548	12.2	126	13.3	148	8.1	257	16.3
28 - Failure to use specialized equipment	8	0.2	1	0.1	1	0.1	5	0.3
92 - Affected by physical condition	389	8.7	66	7.0	240	13.1	70	4.4
98 - Other improper driving actions	323	7.2	65	6.8	111	6.0	131	8.3
99 - Unknown	53	1.2	6	0.6	15	0.8	28	1.8
Total	4,494	100.0	949	100.0	1,836	100.0	1,576	100.0
Missing Value	23,268		4,180		11,380		6,947	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B46. Driver Action #3

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
00 - No contributing action	268	17.9	39	13.0	100	19.1	123	19.9
01 - Driver was distracted	17	1.1	3	1.0	5	1.0	8	1.3
04 - Making illegal U-turn	1	0.1					1	0.2
05 - Making improper or careless turn	18	1.2	3	1.0	9	1.7	6	1.0
06 - Turning from wrong lane	2	0.1			2	0.4		
07 - Proceeding w/o clearance after stop	1	0.1					1	0.2
08 - Running stop sign	11	0.7			4	0.8	6	1.0
09 - Running red light	3	0.2					3	0.5
10 - Failure to respond to TCD	8	0.5			4	0.8	4	0.6
11 - Tailgating	14	0.9	6	2.0	5	1.0	3	0.5
12 - Sudden slowing or stopping	22	1.5	5	1.7	8	1.5	9	1.5
14 - Careless passing or lane change	17	1.1	6	2.0	4	0.8	7	1.1
15 - Passing in no passing zone	10	0.7	4	1.3	3	0.6	3	0.5
17 - Careless or illegal backing on roadway	1	0.1					1	0.2
18 - Driving on the wrong side of roadway	101	6.8	22	7.3	50	9.6	26	4.2
19 - Making improper entrance to highway	5	0.3	1	0.3	2	0.4	1	0.2
20 - Making improper exit from highway	8	0.5	1	0.3	4	0.8	3	0.5
22 - Over or under compensation at curve	150	10.0	44	14.6	54	10.3	45	7.3
23 - Speeding	79	5.3	23	7.6	22	4.2	32	5.2
24 - Driving too fast for conditions	155	10.4	24	8.0	56	10.7	71	11.5
25 - Failure to maintain proper speed	68	4.5	13	4.3	13	2.5	39	6.3
26 - Driver fleeing police (police chase)	9	0.6	3	1.0	2	0.4	3	0.5
27 - Driver inexperienced	213	14.2	58	19.3	43	8.2	103	16.6
28 - Failure to use specialized equipment	5	0.3			1	0.2	3	0.5
92 - Affected by physical condition	125	8.4	21	7.0	80	15.3	20	3.2
98 - Other improper driving actions	157	10.5	23	7.6	49	9.4	77	12.4
99 - Unknown	28	1.9	2	0.7	3	0.6	21	3.4
Total	1,496	100.0	301	100.0	523	100.0	619	100.0
Missing Value	26,266		4,828		12,693		7,904	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B47. Driver Action #4

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
00 - No contributing action	284	44.3	41	36.6	107	51.0	129	43.4
01 - Driver was distracted	11	1.7	2	1.8	4	1.9	4	1.3
04 - Making illegal U-turn	1	0.2			1	0.5		
05 - Making improper or careless turn	1	0.2					1	0.3
06 - Turning from wrong lane	4	0.6			3	1.4	1	0.3
07 - Proceeding w/o clearance after stop	1	0.2			1	0.5		
08 - Running stop sign	1	0.2						
09 - Running red light	2	0.3	1	0.9			1	0.3
11 - Tailgating	1	0.2	1	0.9				
12 - Sudden slowing or stopping	7	1.1			1	0.5	5	1.7
14 - Careless passing or lane change	3	0.5	2	1.8			1	0.3
15 - Passing in no passing zone	1	0.2					1	0.3
17 - Careless or illegal backing on roadway	1	0.2					1	0.3
18 - Driving on the wrong side of roadway	26	4.1	6	5.4	12	5.7	8	2.7
19 - Making improper entrance to highway	1	0.2					1	0.3
20 - Making improper exit from highway	1	0.2	1	0.9			8	2.7
22 - Over or under compensation at curve	18	2.8	5	4.5	5	2.4		
23 - Speeding	18	2.8	6	5.4	7	3.3	5	1.7
24 - Driving too fast for conditions	26	4.1	6	5.4	10	4.8	10	3.4
25 - Failure to maintain proper speed	9	1.4	1	0.9	2	1.0	6	2.0
26 - Driver fleeing police (police chase)	7	1.1	2	1.8	1	0.5	4	1.3
27 - Driver inexperienced	67	10.5	15	13.4	11	5.2	39	13.1
28 - Failure to use specialized equipment	5	0.8	1	0.9	1	0.5	2	0.7
92 - Affected by physical condition	38	5.9	7	6.3	24	11.4	7	2.4
98 - Other improper driving actions	77	12.0	13	11.6	16	7.6	41	13.8
99 - Unknown	30	4.7	2	1.8	4	1.9	22	7.4
Total	641	100.0	112	100.0	210	100.0	297	100.0
Missing Value	27,121		5,017		13,006		8,226	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B48. Weather Type

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No adverse conditions	26,760	96.4	4,999	97.5	12,704	96.1	8,197	96.2
Rain	696	2.5	77	1.5	385	2.9	213	2.5
Sleet (hail)	10	0.0	1	0.0	6	0.0	3	0.0
Snow	15	0.1			4	0.0	9	0.1
Fog	105	0.4	19	0.4	52	0.4	30	0.4
Rain and fog	17	0.1	1	0.0	7	0.1	7	0.1
Sleet and fog	10	0.0			2	0.0	8	0.1
Other	30	0.1	3	0.1	11	0.1	14	0.2
Unknown	117	0.4	29	0.6	43	0.3	42	0.5
Total	27,760	100.0	5,129	100.0	13,214	100.0	8,523	100.0

Table B49. Initial MBAC Age

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
10 to 19	2,669	14.1	1,060.00	25.94	585.00	6.85	943.00	16.08
20 to 29	7,191	37.9	2,330.00	57.02	2,145.00	25.13	2,586.00	44.10
30 to 39	4,712	24.9	495.00	12.11	2,873.00	33.67	1,238.00	21.11
40 to 49	2,991	15.8	140.00	3.43	2,055.00	24.08	718.00	12.24
50 to 59	1,147	6.1	49.00	1.20	735.00	8.61	318.00	5.42
60 to 69	213	1.1	11.00	0.27	129.00	1.51	51.00	0.87
70+	29	0.2	1.00	0.02	12.00	0.14	10.00	0.17
Total	18,952	100.0	4,086	100.0	8,534	100.0	5,864	100.0
Missing Value	8,810		1,043		4,682		2,659	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B50. Number of Motorcycles Involved in Crash

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
1	26,484	95.4	4,912	95.8	12,559	95.0	8,151	95.6
2	1,184	4.3	203	4.0	598	4.5	351	4.1
3	72	0.3	8	0.2	49	0.4	15	0.2
4	17	0.1	6	0.1	6	0.0	5	0.1
5	5	0.0			4	0.0	1	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B51. Anyone Killed

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
No	26,373	95.0	4,816	93.9	12,539	94.9	8,163	95.8
Yes	1,389	5.0	313	6.1	677	5.1	360	4.2
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table B52. Prime Unit Number

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	2	0.0			1	0.0	1	0.0
1	7,315	91.9	1,398	90.5	3,524	93.1	2,253	90.9
2	629	7.9	145	9.4	254	6.7	220	8.9
3	10	0.1	1	0.1	6	0.2	3	0.1
4	3	0.0			2	0.1	1	0.0
Total	7,959	100.0	1,544	100.0	3,787	100.0	2,478	100.0
Missing Value	19,803		3,585		9,429		6,045	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B53. Age at Date of Crash

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
10 to 19	1,775	6.4	635	12.4	302	2.3	709	8.4
20-29	8,120	29.4	2,959	57.9	1,723	13.1	3,232	38.1
30-39	6,450	23.3	969	19.0	3,408	25.9	1,892	22.3
40-49	6,372	23	331	6.5	4,433	33.7	1,447	17.0
50-59	3,659	13.2	155	3.0	2,524	19.2	868	10.2
60-69	1,034	3.7	50	1.0	665	5.1	268	3.2
70+	239	0.9	10	0.2	112	0.9	72	0.8
Total	27,649	100	5,109	100.0	13,167	100.0	8,488	100.0
Missing Value	113		20		49		35	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B54. Engine Size

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0-199cc	377	2.1			82	0.8	115	5.9
200-399cc	704	3.9	212	4.1	230	2.2	68	3.5
400-599cc	1,187	6.5	261	5.1	743	7.0	142	7.3
600-799cc	5,832	32	3,203	62.5	1,352	12.8	1,098	56.2
800-999cc	1,877	10.3	436	8.5	1,234	11.7	197	10.1
1000-1199cc	2,249	12.3	840	16.4	1,245	11.8	156	8.0
1200-1399cc	3,850	21.1	171	3.3	3,558	33.8	114	5.8
1400-1599cc	1,890	10.4			1,845	17.5	36	1.8
1600-1799cc	171	0.9	1	0.0	151	1.4	19	1.0
1800-2000cc	110	0.6			100	0.9	8	0.4
Total	18,247	100	5,124	100.0	10,540	100.0	1,953	100.0
Missing Value	9,515		5		2,676		6,570	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B55. Crash Time of Day

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
10pm - 2am	2,856	10.4	541	10.6	1,396	10.6	888	10.6
2am - 6am	1,026	3.7	181	3.6	538	4.1	320	3.8
6am - 10am	2,026	7.4	347	6.8	968	7.4	627	7.5
10am - 2pm	5,027	18.3	839	16.5	2,470	18.8	1,447	17.3
2pm - 6pm	9,480	34.5	1,785	35.0	4,524	34.5	2,839	33.9
6pm - 10pm	7,063	25.7	1,402	27.5	3,215	24.5	2,264	27.0
Total	27,478	100.0	5,095	100.0	13,111	100.0	8,385	100.0
Missing Value	284		34		105		138	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B56. MBAC tenure (in months) at crash

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
-120 to -80	48	0.3	8	0.2	22	0.3	17	0.3
-79 to -40	142	0.7	21	0.6	62	0.9	53	1.0
-39 to - 1	423	2.2	88	2.3	151	2.3	169	3.3
0	650	3.4	190	5.0	192	2.9	250	4.9
1 to 10	4,381	23.1	1,246	32.8	1,455	21.8	1,551	30.3
11 to 20	2,607	13.7	693	18.2	1,018	15.3	843	16.5
21 to 30	1,819	9.6	430	11.3	767	11.5	570	11.1
31 to 40	1,360	7.2	296	7.8	590	8.8	445	8.7
41+	7,535	39.7	829	21.8	2,417	36.2	1,215	23.8
Total	18,965	100.0	3,801	100.0	6,674	100.0	5,113	100.0
Missing Value	8,797		1,328		6,542		3,410	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table B57. Total People in Crash

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
1	12,281	44.4	2,552	49.9	5,451	41.4	3,882	45.7
2	9,788	35.4	1,636	32.0	4,745	36.0	3,065	36.1
3	3,471	12.5	560	11.0	1,826	13.9	987	11.6
4	1,276	4.6	214	4.2	670	5.1	354	4.2
5	540	2.0	94	1.8	300	2.3	131	1.5
6	235	0.8	42	0.8	127	1.0	64	0.8
7	81	0.3	16	0.3	45	0.3	19	0.2
Total	27,672	100	5,114	100.0	13,164	100.0	8,502	100.0
Missing Value	90		15		52		21	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Appendix C:
Frequency Distributions for PAMSP Variables

Table C1. MSP Website Registration

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	18,684	67.3	3,381	65.9	8,855	67.0	5,723	67.1
Yes	9,078	32.7	1,748	34.1	4,361	33.0	2,800	32.9
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C2. BRC Pass

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	25,684	92.5	4,697	91.6	12,392	93.8	7,746	90.9
Yes	2,078	7.5	432	8.4	824	6.2	777	9.1
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C3. ERC Pass

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	27,454	98.9	5,081	99.1	13,044	98.7	8,446	99.1
Yes	308	1.1	48	0.9	172	1.3	77	0.9
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C4. Pass Grade Ever

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	25,434	91.6	4,661	90.9	12,244	92.6	7,688	90.2
Yes	2,328	8.4	468	9.1	972	7.4	835	9.8
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C5. Registered for BRC Ever

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	24,878	89.6	4,489	87.5	12,138	91.8	7,415	87.0
Yes	2,884	10.4	640	12.5	1,078	8.2	1,108	13.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C6. Registered for ERC Ever

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	27,265	98.2	5,049	98.4	12,958	98.0	8,378	98.3
Yes	497	1.8	80	1.6	258	2.0	145	1.7
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C7. MSP Records Start Date

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No MBAC	8,797	31.7	1,043	20.3	4,679	35.4	2,649	31.1
MBAC before Start of MSP Records	15,386	55.4	3,121	60.9	7,476	56.6	4,430	52.0
MBAC after Start of MSP Records	3,579	12.9	965	18.8	1,061	8.0	1,444	16.9
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C8. Registered for MSP Course Ever

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	24,541	88.4	4,442	86.6	11,943	90.4	7,329	86.0
Yes	3,221	11.6	687	13.4	1,273	9.6	1,194	14.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C9. Number of MSP Course Registrations

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
1	2,311	72.1	501	72.9	915	72.4	856	72.0
2	674	21.0	143	20.8	275	21.8	237	19.9
3	164	5.1	33	4.8	51	4.0	73	6.1
4	39	1.2	7	1.0	16	1.3	16	1.3
5	13	0.4	2	0.3	5	0.4	6	0.5
6	3	0.1			2	0.2	1	0.1
7	1	0.0	1	0.1				
Total	3,205	100.0	687	100.0	1,264	100.0	1,189	100.0
Missing Value	24,557		4,442		11,952		7,334	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C10. Skill Retest Ever

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	27,754	100.0	5,129	100.0	13,213	100.0	8,519	100.0
Yes	8	0.0	0	0.0	3	0.0	4	0.0
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C11. BRC Pass to Crash in Months

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
more than -50	165	7.9	42	9.7	83	10.1	38	4.9
-49 to -1	520	25.0	90	20.8	197	23.9	222	28.6
0	82	3.9	14	3.2	33	4.0	34	4.4
1	131	6.3	25	5.8	47	5.7	57	7.3
2	106	5.1	23	5.3	45	5.5	34	4.4
3-4	129	6.2	32	7.4	47	5.7	48	6.2
5-6	68	3.3	11	2.5	29	3.5	25	3.2
7-8	76	3.7	17	3.9	30	3.6	29	3.7
9-10	101	4.9	24	5.6	33	4.0	40	5.1
11+	700	33.7	154	35.6	280	34.0	250	32.2
Total	2,078	100.0	432	100.0	824	100.0	777	100.0
Missing Value	25,684		4,697		12,392		7,746	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C12. ERC Pass to Crash in Months

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
more than -50	63	20.5	10	20.8	43	25.0	9	11.7
-49 to -1	110	35.7	13	27.1	56	32.6	38	49.4
0	11	3.6	1	2.1	7	4.1	3	3.9
1	13	4.2	5	10.4	7	4.1		
2	12	3.9	2	4.2	2	1.2	8	10.4
3-4	8	2.6	4	8.3	3	1.7	1	1.3
5-6	3	1.0	1	2.1	2	1.2		
7-8	6	1.9	1	2.1	4	2.3	1	1.3
9-10	7	2.3	1	2.1	4	2.3		
11+	75	24.4	10	20.8	44	25.6	17	22.1
Total	308	100.0	48	100.0	172	100.0	77	100.0
Missing Value	27,454		5,081		13,044		8,446	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C13. BRC Fail to Crash in Months

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
more than -50	16	5.7	3	6.4	8	7.0	5	4.4
-49 to -1	62	22.1	8	17.0	31	27.2	22	19.5
0	34	12.1	7	14.9	12	10.5	15	13.3
1	17	6.1	3	6.4	6	5.3	8	7.1
2	18	6.4	5	10.6	8	7.0	5	4.4
3-4	20	7.1	5	10.6	5	4.4	9	8.0
5-6	9	3.2	1	2.1	5	4.4	3	2.7
7-8	6	2.1			3	2.6	3	2.7
9-10	10	3.6	3	6.4	2	1.8	4	3.5
11+	88	31.4	12	25.5	34	29.8	39	34.5
Total	280	100.0	47	100.0	114	100.0	113	100.0
Missing Value	27,482		5,082		13,102		8,410	
	27,762		5,129		13,216		8,523	

Table C14. ERC Fail to Crash in Months

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
more than -50	5	31.25	1	100.0	4	33.3		
-49 to -1	5	31.25			4	33.3	1	50.0
0	3	18.75			3	25.0		
1	1	6.25						
2	1	6.25			1	8.3		
3-4	0	0.0						
5-6	1	6.3					1	50.0
Total	16	100.0			12	100.0	2	100.0
Missing Value	27,746		5,128		13,204		8,521	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C15. Grade Failed

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
No	27,465	98.9	5,081	99.1	13,089	99.0	8,408	98.7
Yes	297	1.1	48	0.9	127	1.0	115	1.3
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table C16. Pass Grade Ever-2

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
No	893	27.7	219	31.9	301	23.6	359	30.1
Yes	2,328	72.3	468	68.1	972	76.4	835	69.9
Total	3,221	100.0	687	100.0	1,273	100.0	1,194	100.0
Missing Value	24,541		4,442		11,943		7,329	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C17. BRC Pass Age in Decades

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
10 to 19	118	5.7	48	11.1	25	3.0	42	5.4
20 to 29	685	33.0	242	56.0	112	13.6	322	41.5
30 to 39	503	24.2	97	22.5	209	25.4	192	24.7
40 to 49	452	21.8	29	6.7	281	34.1	127	16.4
50 to 59	256	12.3	16	3.7	158	19.2	73	9.4
60 to 69	58	2.8			37	4.5	20	2.6
70+	4	0.2			1	0.1		
Total	2,076	100.0	432	100.0	823	100.0	776	100.0
Missing Value	25,686		4,697		12,393		7,747	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C18. BRC Fail Age in Decades

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
10 to 19	11	3.9	6	12.8			5	4.5
20 to 29	90	32.3	27	57.4	13	11.4	48	42.9
30 to 39	47	16.8	7	14.9	19	16.7	20	17.9
40 to 49	66	23.7	5	10.6	40	35.1	20	17.9
50 to 59	54	19.4	2	4.3	34	29.8	16	14.3
60 to 69	7	2.5			5	4.4	2	1.8
70+	4	1.4			3	2.6	1	0.9
Total	279	100.0	47	100.0	114	100.0	112	100.0
Missing Value	27,483		5,082		13,102		8,411	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C19. ERC Pass Age in Decades

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
10 to 19	2	0.6	1	2.1				
20 to 29	43	14.0	18	37.5	4	2.3	19	24.7
30 to 39	53	17.2	17	35.4	19	11.0	16	20.8
40 to 49	88	28.6	5	10.4	58	33.7	20	26.0
50 to 59	90	29.2	5	10.4	69	40.1	15	19.5
60 to 69	31	10.1	2	4.2	22	12.8	6	7.8
70+	1	0.3					1	1.3
Total	308	100.0	48	100.0	172	100.0	77	100.0
Missing Value	27,454		5,081		13,044		8,446	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C20. ERC Fail Age in Decades

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
10 to 19	0	0.0						
20 to 29	0	0.0						
30 to 39	3	18.8	1	100.0	2	16.7		
40 to 49	3	18.8			3	25.0		
50 to 59	6	37.5			4	33.3	2	100.0
60 to 69	1	6.3			1	8.3		
70+	3	18.8			2	16.7		
Total	16	100.0	1		12	100.0	2	
Missing Value	27,746		5,128		13,204		8,521	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C21. Best Skills Test Score

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0 to 4	882	39.2	210	45.8	335	36.5	318	38.7
5 to 9	673	29.9	145	31.6	280	30.5	236	28.7
10 to 14	416	18.5	69	15.0	173	18.8	160	19.5
15 to 19	204	9.1	29	6.3	87	9.5	84	10.2
20 to 24	55	2.4	4	0.9	34	3.7	16	1.9
25 to 29	9	0.4			4	0.4	4	0.5
30+	13	0.6	2	0.4	5	0.5	4	0.5
Total	2,252	100.0	459	100.0	918	100.0	822	100.0
Missing Value	25,510		4,670		12,298		7,701	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C22. Worst Skills Test Score

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
0 to 4	847	37.6	200	43.6	321	35.0	307	37.3
5 to 9	674	29.9	149	32.5	276	30.1	237	28.8
10 to 14	414	18.4	71	15.5	171	18.6	158	19.2
15 to 19	199	8.8	29	6.3	88	9.6	78	9.5
20 to 24	73	3.2	5	1.1	44	4.8	23	2.8
25 to 29	16	0.7			8	0.9	7	0.9
30+	29	1.3	5	1.1	10	1.1	12	1.5
Total	2,252	100.0	459	100.0	918	100.0	822	100.0
Missing Value	25,510		4,670		12,298		7,701	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C23. Knowledge Test Score Maximum

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
0 to 80	26	1.2	4	0.9	10	1.2	12	1.5
81 to 90	331	15.4	60	13.6	142	16.5	124	15.5
91 to 95	487	22.7	94	21.3	197	22.9	180	22.5
96 to 97	407	19.0	99	22.4	160	18.6	143	17.9
98 to 100	895	41.7	184	41.7	350	40.7	340	42.6
Total	2,146	100.0	441	100.0	859	100.0	799	100.0
Missing Value	25,616		4,688		12,357		7,724	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table C24. Knowledge Test Score Minimum

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**	**Frequency**	**Percent of Total**
0 to 80	42	2.0	7	1.6	16	1.9	18	2.3
81 to 90	326	15.2	59	13.4	143	16.6	120	15.0
91 to 95	496	23.1	95	21.5	198	23.1	187	23.4
96 to 97	403	18.8	97	22.0	161	18.7	140	17.5
98 to 100	879	41.0	183	41.5	341	39.7	334	41.8
Total	2,146	100.0	441	100.0	859	100.0	799	100.0
Missing Value	25,616		4,688		12,357		7,724	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Appendix D:
Frequency Distributions for Driver Record Variables

Table D1. Motorcycle Driver Gender

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
Female	1,422	5.1	142	2.8	737	5.6	445	5.2
Male	26,313	94.9	4,982	97.1	12,471	94.4	8,066	94.6
Total	27,735	100.0	5,124	100.0	13,208	100.0	8,511	100.0
Missing Value	27							
Total (Observed + Missing)	27,762							

Table D2. Motorcycle Driver Failures to Stop/Yield

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	19,183	77.4	3,422	76.0	9,695	77.9	5,553	77.3
1	3,631	14.7	703	15.6	1,770	14.2	1,066	14.8
2	1,211	4.9	237	5.3	585	4.7	368	5.1
3	451	1.8	83	1.8	238	1.9	124	1.7
4	174	0.7	37	0.8	89	0.7	42	0.6
5 or greater	119	0.5	20	0.4	67	0.5	29	0.4
Total	24,769	100	4,502	100.0	12,444	100.0	7,182	100.0
Missing Value	2,993		627		772		1,341	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D3. Motorcycle Driver Speeding Violations

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	13,129	53.0	2,115	47.0	6,728	54.1	3,899	54.3
1 to 5	10,447	42.2	2,151	47.8	5,079	40.8	2,987	41.6
6 to 10	1,050	4.2	219	4.9	550	4.4	260	3.6
11 +	143	0.6	17	0.4	87	0.7	36	0.5
Total	24,769	100.0	4,502	100.0	12,444	100.0	7,182	100.0
Missing Value	2,993		627		772		1,341	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D4. Motorcycle Driver Improper Driving Violations

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	18,942	76.5	3,146	69.9	9,778	78.6	5,492	76.5
1 to 5	5,715	23.1	1,335	29.7	2,613	21.0	1,655	23.0
6 to 10	110	0.4	20	0.4	53	0.4	34	0.5
11 +	2	0.0	1	0.0			1	0.0
Total	24,769	100.0	4,502	100.0	12,444	100.0	7,182	100.0
Missing Value	2,993		627		772		1,341	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D5. Motorcycle Driver Number of DUI

	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
Value Label	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	21,208	85.6	4,010	89.1	10,282	82.6	6,351	88.4
1	529	2.1	104	2.3	281	2.3	133	1.9
2	1,818	7.3	262	5.8	1,068	8.6	448	6.2
3	535	2.2	79	1.8	317	2.5	128	1.8
4	362	1.5	26	0.6	254	2.0	74	1.0
5	149	0.6	12	0.3	107	0.9	27	0.4
6	79	0.3	7	0.2	56	0.5	13	0.2
7	51	0.2	2	0.0	44	0.4	5	0.1
8	19	0.1			17	0.1	2	0.0
9	8	0.0			8	0.1		
10	6	0.0			6	0.0		
11	3	0.0			3	0.0		
12	2	0.0			1	0.0	1	0.0
Total	24,769	100.0	4,502	100.0	12,444	100.0	7,182	100.0
Missing Value	2,993		627		772		1,341	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D6. License class from Driving Records May 2008

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
	3,020	10.9	632	12.3	777	5.9	1,355	15.9
A	2	0.0			1	0.0	1	0.0
AM	9	0.0			6	0.0	3	0.0
B	1	0.0						
BM	9	0.0	1	0.0	7	0.1	1	0.0
C	6,553	23.6	1,868	36.4	2,075	15.7	2,397	28.1
CM	14,039	50.6	2,114	41.2	7,811	59.1	3,767	44.2
M	8	0.0	1	0.0	3	0.0	4	0.0
X	698	2.5	125	2.4	334	2.5	222	2.6
XM	2,210	8.0	215	4.2	1,501	11.4	456	5.4
Y	274	1.0	70	1.4	112	0.8	87	1.0
YM	899	3.2	102	2.0	561	4.2	220	2.6
Z	8	0.0			5	0.0	3	0.0
ZM	32	0.1	1	0.0	23	0.2	7	0.1
Total	27,762	100.0	5,129	100.0	13,216	100.0	8,523	100.0

Table D7. Number of Suspensions

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	15,934	64.3	2,670	59.3	8,249	66.3	4,549	63.4
1 to 5	6,096	24.6	1,221	27.1	3,037	24.4	1,716	23.9
6 to 10	1,438	5.8	315	7.0	659	5.3	433	6.0
11 to 20	901	3.6	204	4.5	367	2.9	321	4.5
21 to 30	244	1	56	1.2	91	0.7	90	1.3
31 +	156	0.6	35	0.8	39	0.3	68	0.9
Total	24,769	100	4,501	100.0	12,442	100.0	7,177	100.0
Missing Value	2,993		628		774		1,346	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D8. Number of Sanctions

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	14,917	60.2	2,423	53.8	7,805	62.7	4,246	59.2
1 to 5	6,762	27.3	1,408	31.3	3,291	26.5	1,928	26.9
6 to 10	1,646	6.6	337	7.5	779	6.3	490	6.8
11 to 20	1,013	4.1	238	5.3	420	3.4	345	4.8
21 to 30	264	1.1	58	1.3	106	0.9	95	1.3
31 +	167	0.7	37	0.8	41	0.3	73	1.0
Total	24,769	100.0	4,501	100.0	12,442	100.0	7,177	100.0
Missing Value	2,993		628		774		1,346	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D9. Number of Driving Violations

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	10,861	43.8	1,714	38.1	5,684	45.7	3,152	43.9
1 to 5	9,430	38.1	1,895	42.1	4,438	35.7	2,853	39.7
6 to 10	3,075	12.4	670	14.9	1,507	12.1	838	11.7
11 to 20	1,267	5.1	202	4.5	732	5.9	309	4.3
21 to 30	121	0.5	21	0.5	71	0.6	28	0.4
31+	15	0.1			12	0.1	2	0.0
Total	24,769	100.0	4,502	100.0	12,444	100.0	7,182	100.0
Missing Value	2,993		627		772		1,341	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D10. Number of License Restrictions

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	21,520	86.9	3,856	85.7	10,904	87.6	6,180	86.0
1 to 5	2,973	12.0	600	13.3	1,414	11.4	907	12.6
6 to 10	227	0.9	38	0.8	103	0.8	79	1.1
11 to 20	47	0.2	8	0.2	22	0.2	15	0.2
21 to 30	2	0.0			1	0.0	1	0.0
Total	24,769	100.0	4,502	100.0	12,444	100.0	7,182	100.0
Missing Value	2,993		627		772		1,341	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D11. Total Number of Violations and Sanctions

Value Label	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	3,002	17.3	341	10.6	1,712	19.8	845	16.8
1-2	3,593	20.7	626	19.5	1,801	20.8	1,045	20.8
3-4	1,979	11.4	379	11.8	1,011	11.7	546	10.9
5-10	3,685	21.3	759	23.7	1,763	20.4	1,090	21.7
11-20	2,689	15.5	592	18.5	1,303	15.0	737	14.7
over 20	2,387	13.8	508	15.9	1,071	12.4	759	15.1
Total	17,335	100.0	3,205	100.0	8,661	100.0	5,022	100.0
Missing Value	10,427		1,924		4,555		3,501	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D12. Total Violations Number

Value Label	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	3,002	17.3	341	10.6	1,712	19.8	845	16.8
1-2	4,427	25.5	810	25.3	2,196	25.3	1,282	25.5
3-4	2,825	16.3	606	18.9	1,333	15.4	827	16.5
5-10	4,250	24.5	884	27.6	2,061	23.8	1,214	24.2
11-20	2,037	11.7	413	12.9	1,016	11.7	576	11.5
over 20	796	4.6	152	4.7	346	4.0	281	5.6
Total	17,337	100.0	3,206	100.0	8,664	100.0	5,025	100.0
Missing Value	10,425		1,923		4,552		3,498	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D13. Number of Failure to Respond

Value Label	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	12,705	73.3	2,127	66.3	6,765	78.1	3,451	68.7
1-2	2,253	13.0	485	15.1	1,022	11.8	705	14.0
3-4	867	5.0	216	6.7	364	4.2	273	5.4
5-6	476	2.7	119	3.7	177	2.0	175	3.5
7+	1,035	6.0	259	8.1	336	3.9	420	8.4
Total	17,336	100.0	3,206	100.0	8,664	100.0	5,024	100.0
Missing Value	10,426		1,923		4,552		3,499	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D14. Number of Other Violations

Value Label	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	15,201	87.7	2,849	88.9	7,553	87.2	4,397	87.5
1-2	1,900	11.0	334	10.4	961	11.1	570	11.3
3-4	153	0.9	17	0.5	98	1.1	34	0.7
5-6	56	0.3	4	0.1	38	0.4	14	0.3
7+	27	0.2	2	0.1	14	0.2	10	0.2
Total	17,337	100.0	3,206	100.0	8,664	100.0	5,025	100.0
Missing Value	10,425		1,923		4,552		3,498	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D15. Number of Non-highway Safety Violations

Value Label	All Bike Types		Sport Bikes		Cruisers		Unknown Bike Types	
	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total	Frequency	Percent of Total
0	15,802	91.1	2,778	86.7	8,118	93.7	4,515	89.9
1-2	1,356	7.8	375	11.7	492	5.7	449	8.9
3-4	131	0.8	37	1.2	40	0.5	45	0.9
5-6	36	0.2	8	0.2	12	0.1	14	0.3
7+	12	0.1	8	0.2	2	0.0	2	0.0
Total	17,337	100.0	3,206	100.0	8,664	100.0	5,025	100.0
Missing Value	10,425		1,923		4,552		3,498	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D16. Number of Non-Violations

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	16,005	92.3	3,049	95.1	7,874	90.9	4,669	92.9
1-2	1,282	7.4	152	4.7	760	8.8	341	6.8
3-4	43	0.2	4	0.1	26	0.3	13	0.3
5-6	6	0.0	1	0.0	4	0.0	1	0.0
7+	1	0.0					1	0.0
Total	17,337	100.0	3,206	100.0	8,664	100.0	5,025	100.0
Missing Value	10,425		1,923		4,552		3,498	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D17. Number of 6pt Exams

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	12,138	70.0	2,013	62.8	6,234	72.0	3,551	70.7
1-2	5,120	29.5	1,183	36.9	2,379	27.5	1,457	29.0
3-4	78	0.4	10	0.3	51	0.6	16	0.3
5-6	1	0.0					1	0.0
Total	17,337	100.0	3,206	100.0	8,664	100.0	5,025	100.0
Missing Value	10,425		1,923		4,552		3,498	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D18. Number of Exams

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	11,895	68.6	1,954	60.9	6,152	71.0	3,453	68.7
1-2	5,328	30.7	1,238	38.6	2,439	28.2	1,547	30.8
3-4	112	0.6	14	0.4	72	0.8	24	0.5
5-6	2	0.0			1	0.0	1	0.0
Total	17,337	100.0	3,206	100.0	8,664	100.0	5,025	100.0
Missing Value	10,425		1,923		4,552		3,498	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D19. Number of Hearings

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	14,643	84.5	2,544	79.4	7,452	86.0	4,262	84.8
1-2	2,255	13.0	564	17.6	1,002	11.6	639	12.7
3-4	348	2.0	84	2.6	158	1.8	99	2.0
5-6	64	0.4	10	0.3	34	0.4	20	0.4
7+	27	0.2	4	0.1	18	0.2	5	0.1
Total	17,337	100.0	3,206	100.0	8,664	100.0	5,025	100.0
Missing Value	10,425		1,923		4,552		3,498	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Table D20. Number of Disqualifications

Value Label	All Bike Types Frequency	All Bike Types Percent of Total	Sport Bikes Frequency	Sport Bikes Percent of Total	Cruisers Frequency	Cruisers Percent of Total	Unknown Bike Types Frequency	Unknown Bike Types Percent of Total
0	17,267	99.6	3,199	99.8	8,615	99.4	5,012	99.7
1-2	66	0.4	7	0.2	45	0.5	13	0.3
3-4	4	0.0			4	0.0		
Total	17,337	100.0	3,206	100.0	8,664	100.0	5,025	100.0
Missing Value	10,425		1,923		4,552		3,498	
Total (Observed + Missing)	27,762		5,129		13,216		8,523	

Appendix E: Violations Codes and Categories

Table E1. Vehicle Violations – License Restriction (Category 1)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
A3742.1	ARD ACC DEATH/INJ NO LIC	ARD ACCIDENTAL DEATH/INJURY NO LIC
A1371	ARD-DRIVE WHILE SUSP/REVO	ARD-DRIVE WHILE SUSP/REVO
A1543	ARD-DRIVE WHILE SUSP/REVO	ARD-DRIVE WHILE SUSP/REVO
A1543A	ARD-DRIVE WHILE SUSP/REVO	ARD-DRIVE WHILE SUSP/REVO
A1606A	ARD-DRVNG CMV WITHOUT CDL	ARD-DRIVING COMMERCIAL MOTOR VEHICLE WITHOUT CDL
A1606C1I	ARD-DRVNG CMV WTH PRV REM	ARD-DRIVING COMMERCIAL MOTOR VEHICLE WTH PRV REM
A1606C12	ARD-DRVNG CMV WTH PRV SUS	ARD-DRIVING COMMERCIAL MOTOR VEHICLE WTH PRV SUS
A1543B	ARD-DRVNG UNDR ALC SUSP	ARD-DRIVING UNDR ALC SUSP
A1606C13	ARD-DRVNG WHL OOSO IN EFF	ARD-DRIVING WHL OOSO IN EFF
A1543B11	ARD-DRVNG WHL SUS-ALC/DRG	ARD-DRIVING WHL SUS-ALC/DRG
A1501A	ARD-OPER MUST BE LICENSED	ARD-OPER MUST BE LICENSED
1503C	CURFEW VIOLATION	CURFEW VIOLATION
1503C1	CURFEW VIOLATION	CURFEW VIOLATION
1503C2	CURFEW VIOLATION	CURFEW VIOLATION
1371	DRIVE WHILE REG.SUSP/REVO	DRIVE WHILE REG.SUSP/REVO
1606A	DRIVING CMV WITHOUT CDL	DRIVING COMMERCIAL MOTOR VEHICLE WITHOUT CDL
1543	DRIVING WHILE SUSP/REVOKE	DRIVING WHILE SUSP/REVOKE
1543A	DRIVING WHILE SUSP/REVOKE	DRIVING WHILE SUSP/REVOKE
1432A	DRIVING WHILE SUSPENDED	DRIVING WHILE SUSPENDED
1543R	DRIVING WHILE UNDER REVOC	DRIVING WHILE UNDER REVOC
1543S	DRIVING WHILE UNDER SUSP	DRIVING WHILE UNDER SUSP
1543X	DRIVING WHILE UNDER SUSP	DRIVING WHILE UNDER SUSP
6246	DRVING W/ SUSP/REVO	DRIVING W/ SUSP/REVO
1606C1	DRVNG CMV WITH PRIV REMOV	DRIVING COMMERCIAL MOTOR VEHICLE WITH PRIV REMOV
1606C1I	DRVNG CMV WITH PRIV REMOV	DRIVING COMMERCIAL MOTOR VEHICLE WITH PRIV REMOV
1606C1II	DRVNG CMV WITH PRIV SUSP	DRIVING COMMERCIAL MOTOR VEHICLE WITH PRIV SUSP
1543B	DRVNG UNDR ALCHOL REL SUS	DRIVING UNDR ALCHOL REL SUS
1543B1.1	DRVNG UNDR SUSP ALC/DRUG	DRIVING UNDR SUSP ALC/DRUG
6247	DRVNG W/ REGIS SUSP/REVO	DRIVING W/ REGIS SUSP/REVO
B21	DRVNG W/LIC BARRED	DRIVING W/LIC BARRED
B22	DRVNG W/LIC CNCLLD	DRIVING W/LIC CNCLLD
B20	DRVNG W/LIC WITHDRWN	DRIVING W/LIC WITHDRWN
B23	DRVNG WHILE LIC DEN	DRIVING WHILE LIC DEN
B24	DRVNG WHILE LIC DISQ	DRIVING WHILE LIC DISQ
B25	DRVNG WHILE LIC REV	DRIVING WHILE LIC REV
B26	DRVNG WHILE LIC SUSP	DRIVING WHILE LIC SUSP
1606C13	DRVNG WHL OOSO IN EFFECT	DRIVING WHL OOSO IN EFFECT
B51	EXPIRED OR NO DL	EXPIRED OR NO DRIVERS LICENSE
606A	LEARNER PERMIT USAGEVIOLT	LEARNER PERMIT USAGEVIOLT
1501	NO LICENSE	NO LICENSE
4962	NO TRIP PERMIT	NO TRIP PERMIT

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
616B	OPER UNDER REVOCATION	OPER UNDER REVOCATION
1501A	OPERATOR MUST BE LICENSED	OPERATOR MUST BE LICENSED
601A	OPERATOR MUST BE LICENSED	OPERATOR MUST BE LICENSED
601B	OPERATOR MUST BE LICENSED	OPERATOR MUST BE LICENSED
6241	TO DISPLAY SUSPENDEDLIC	TO DISPLAY SUSPENDEDLIC
A1512	VIOLATE RESTRICTED LICENS	VIOLATE RESTRICTED LICENS
1512	VIOLATION OF RESTRICTION	VIOLATION OF RESTRICTION
88.3A	FAILURE TO MAINTAIN II	FAILURE TO MAINTAIN II
B91	IMPROP CLASS ON DL	IMPROPER CLASS ON DRIVERS LICENSE
A3808B	ARD-INTERLOCK TAMPERING	ARD-INTERLOCK TAMPERING
A41	DRVR VIOL ING INTRLK	DRVR VIOLATION ING INTRLK
3808B	INTERLOCK TAMPERING	INTERLOCK TAMPERING
7514B	INTERLOCK TAMPERING	INTERLOCK TAMPERING
7514A	NO IGNITION INTERLOCK	NO IGNITION INTERLOCK
9999	1575 WITH NO VIOLATNCODE	1575 WITH NO VIOLATNCODE
3742.1	ACCD INV DEATH/INJ NO LIC	ACCIDENTAL INVOLUNTARY DEATH/INJURY NO LIC
A3808A1	ARD-DRIVING W/O II	ARD-DRIVING W/O II
3808A1	DRIVING W/O II	DRIVING W/O II
3815C4	TREATMENT VIOLATION	TREATMENT VIOLATION
88.4B	UNAUTH REMOVAL OF II	UNAUTH REMOVAL OF II
1554H1	VIOL CONCERNING PL LICENS	VIOLATION CONCERNING PL LICENS
A1553F	VIOLATE OLL	VIOLATE OLL
A1554H1	VIOLATE PROBATIONARYLIC	VIOLATE PROBATIONARYLIC
1553F	VIOLATED OLL	VIOLATED OLL
1571	VIOLS CONCERNING LICENSES	VIOLS CONCERNING LICENSES

Table E2. Vehicle Violations – Failure to Stop / Yield (Category 2)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
A3341A	ARD - FAIL TO STOP AT RR	ARD - FAILURE TO STOP AT RAILROAD
A3342A	ARD - FAIL TO STOP AT RR	ARD - FAILURE TO STOP AT RAILROAD
A3342B	ARD - FAIL TO STOP AT RR	ARD - FAILURE TO STOP AT RAILROAD
A3342E	ARD - FAIL TO STOP AT RR	ARD - FAILURE TO STOP AT RAILROAD
A3742B4	ARD FL TO STOP/CONTRB DTH	ARD FAILURE TO STOP/CONTRB DTH
A1027A	ARD-FAIL TO STOP	ARD-FAILURE TO STOP
1027A	FAIL TO STOP AT ACCIDENT	FAILURE TO STOP AT ACCIDENT
3342A	FAIL TO STOP RR CROSSING	FAILURE TO STOP RAILROAD CROSSING
3342B	FAIL TO STOP RR CROSSING	FAILURE TO STOP RAILROAD CROSSING
3342E	FAIL TO STOP RR CROSSING	FAILURE TO STOP RAILROAD CROSSING
3742B4	FAIL TO STOP/CONTRIBS DTH	FAILURE TO STOP/CONTRIBS DTH
A3344	FAILURE TO STOP	FAILURE TO STOP
1027D	FAILURE TO STOP	FAILURE TO STOP
3344	FAILURE TO STOP	FAILURE TO STOP
P341A	FAILURE TO STOP AT RR	FAILURE TO STOP AT RAILROAD
3341A	FAILURE TO STOP AT RR	FAILURE TO STOP AT RAILROAD
A3302	FAILURE TO YIELD	FAILURE TO YIELD
A3321	FAILURE TO YIELD	FAILURE TO YIELD
A3322	FAILURE TO YIELD	FAILURE TO YIELD
A3323C	FAILURE TO YIELD	FAILURE TO YIELD
A3324	FAILURE TO YIELD	FAILURE TO YIELD
1009A	FAILURE TO YIELD	FAILURE TO YIELD
3302	FAILURE TO YIELD	FAILURE TO YIELD
3321	FAILURE TO YIELD	FAILURE TO YIELD
3322	FAILURE TO YIELD	FAILURE TO YIELD
3323C	FAILURE TO YIELD	FAILURE TO YIELD
3324	FAILURE TO YIELD	FAILURE TO YIELD
A3114A1	FLASHING RED LIGHT VIOL	FLASHING RED LIGHT VIOL
3114A1	FLASHING RED LIGHT VIOL	FLASHING RED LIGHT VIOL
3542	FTY ROW AT CROSSWALK	FAILURE TO YIELD ROW AT CROSSWALK
N21	FTY ROW AT ROTARY	FAILURE TO YIELD ROW AT ROTARY
N22	FTY ROW AT STOP SGN	FAILURE TO YIELD ROW AT STOP SGN
N24	FTY ROW AT TRAF SGNL	FAILURE TO YIELD ROW AT TRAFFIC SGNL
N23	FTY ROW AT TRAFF SGN	FAILURE TO YIELD ROW AT TRAFF SGN
N26	FTY ROW AT YIELD SGN	FAILURE TO YIELD ROW AT YIELD SGN
N05	FTY ROW FUNRL/PARADE	FAILURE TO YIELD ROW FUNRL/PARADE
N09	FTY ROW SCHOOL BUS	FAILURE TO YIELD ROW SCHOOL BUS
N02	FTY ROW TO ANML VEHC	FAILURE TO YIELD ROW TO ANML VEHC
N03	FTY ROW TO CYCLIST	FAILURE TO YIELD ROW TO CYCLIST
N25	FTY ROW UNSGND INTER	FAILURE TO YIELD ROW UNSGND INTER
N30	FTY ROW WARNING DISP	FAILURE TO YIELD ROW WARNING DISP
N31	FTY ROW WHEN TURNING	FAILURE TO YIELD ROW WHEN TURNING
A3325	FTY TO EMERGENCY VEHICLE	FAILURE TO YIELD TO EMERGENCY VEHICLE
3325	FTY TO EMERGENCY VEHICLE	FAILURE TO YIELD TO EMERGENCY VEHICLE
A3112A3I	RED LIGHT VIOLATION	RED LIGHT VIOLATION
A3112A32	RED LIGHT VIOLATION	RED LIGHT VIOLATION

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
3112A3I	RED LIGHT VIOLATION	RED LIGHT VIOLATION
3112A3II	RED LIGHT VIOLATION	RED LIGHT VIOLATION
A3323B	STOP SIGN VIOLATION	STOP SIGN VIOLATION
1016A	STOP SIGN VIOLATION	STOP SIGN VIOLATION
1016B	STOP SIGN VIOLATION	STOP SIGN VIOLATION
3323B	STOP SIGN VIOLATION	STOP SIGN VIOLATION
A3343A	ARD - FAIL TO OBEY AT RR	ARD - FAILURE TO OBEY AT RAILROAD
A3341B1	ARD-CROSSING GATE VIOL	ARD-CROSSING GATE VIOL
A3341B2	ARD-CROSSING GATE VIOL	ARD-CROSSING GATE VIOL
A3343C	ARD-MVNG HVY EQUIP AT RR	ARD-MVNG HVY EQUIPMENT AT RAILROAD
A3343D	ARD-MVNG HVY EQUIP AT RR	ARD-MVNG HVY EQUIPMENT AT RAILROAD
1039B	BLIND PEDESTRIAN	BLIND PEDESTRIAN
3341B	CROSSING GATE VIOLATION	CROSSING GATE VIOLATION
3341B1	CROSSING GATE VIOLATION	CROSSING GATE VIOLATION
3341B2	CROSSING GATE VIOLATION	CROSSING GATE VIOLATION
A3341	FAILURE TO OBEY AT RR	FAILURE TO OBEY AT RAILROAD
3341	FAILURE TO OBEY AT RR	FAILURE TO OBEY AT RAILROAD
3343A	FAILURE TO OBEY AT RR	FAILURE TO OBEY AT RAILROAD
3113	FTO PED CNTL DEVICE	FAILURE TO OBEY PED CNTL DEVICE
3343C	MVNG HVY EQUIP AT RRGC	MVNG HVY EQUIPMENT AT RAILROADGC
3343D	MVNG HVY EQUIP AT RRGC	MVNG HVY EQUIPMENT AT RAILROADGC
A3542A	PEDESTRIAN RIGHT-OF-WAY	PEDESTRIAN RIGHT-OF-WAY
A3547	PEDESTRIAN RIGHT-OF-WAY	PEDESTRIAN RIGHT-OF-WAY
A3549A	PEDESTRIAN RIGHT-OF-WAY	PEDESTRIAN RIGHT-OF-WAY
3542A	PEDESTRIAN RIGHT-OF-WAY	PEDESTRIAN RIGHT-OF-WAY
3547	PEDESTRIAN RIGHT-OF-WAY	PEDESTRIAN RIGHT-OF-WAY
3549A	PEDESTRIAN RIGHT-OF-WAY	PEDESTRIAN RIGHT-OF-WAY
1003	RAILROAD WARNING SIGNALS	RAILROAD WARNING SIGNALS
3342G	REQ UPON APROCHNG TRACKS	REQ UPON APROCHNG TRACKS
1013B	RIGHT OF WAY	RIGHT OF WAY
1013C	RIGHT OF WAY	RIGHT OF WAY
1028A	TRAFFIC LIGHT VIOLATION	TRAFFIC LIGHT VIOLATION
W60	TWO OR MORE RRGC VIOLS	TWO OR MORE RAILROADGC VIOLS
1014A	EXCEPTION TO RIGHT OF WAY	EXCEPTION TO RIGHT OF WAY
1014C	EXCEPTION TO RIGHT OF WAY	EXCEPTION TO RIGHT OF WAY

Table E3. Vehicle Violations – Speeding (Category 3)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
A3362	ARD-EXCEEDING MAX SPEED	ARD-EXCEEDING MAX SPEED
A3365B	ARD-SPEC SPEED LIMITATNS	ARD-SPEC SPEED LIMITATNS
A3365C.1	ARD-SPEEDING IN ACTIVE WZ	ARD-SPEEDING IN ACTIVE WZ
A3365A	ARD-SPEEDING OVER BRIDGE	ARD-SPEEDING OVER BRIDGE
A3365C	ARD-TRK SPEED ON DWNGRDS	ARD-TRK SPEED ON DWNGRDS
1002B1	EXCEEDING MAX SPEED-1002B	EXCEEDING MAX SPEED-1002B
1002B11	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B3	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B4	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B42	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B5	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B6	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B61	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B62	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B64	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B7	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B72	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B8	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B9	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362A	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362B	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362C	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362D	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362E	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362F	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362G	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362H	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362I	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
3362J	EXCEEDING MAXIMUM SPEED	EXCEEDING MAXIMUM SPEED
1002B	EXCEEDING SPEED LIMIT	EXCEEDING SPEED LIMIT
A3364	MINIMUM SPEED	MINIMUM SPEED
3364	MINIMUM SPEED	MINIMUM SPEED
3365B	SPECIAL SPEED LIMITATIONS	SPECIAL SPEED LIMITATIONS
A3327A2	SPEED IN EMERGENCY-AREA	SPEED IN EMERGENCY-AREA
3327A2	SPEED IN EMERGENCY-AREA	SPEED IN EMERGENCY-AREA
1002C	SPEEDING BUS OR TRUCK	SPEEDING BUS OR TRUCK
1002C1	SPEEDING BUS OR TRUCK	SPEEDING BUS OR TRUCK
1002C3	SPEEDING BUS OR TRUCK	SPEEDING BUS OR TRUCK
A3308C.1	SPEEDING DOWNGRADE	SPEEDING DOWNGRADE
3308C.1	SPEEDING DOWNGRADE	SPEEDING DOWNGRADE
3365C.1	SPEEDING IN ACTIVE WZ	SPEEDING IN ACTIVE WZ
1002B2	SPEEDING IN SCHOOL ZONE	SPEEDING IN SCHOOL ZONE
S98	SPEEDING ON FREEWAY	SPEEDING ON FREEWAY
3365A	SPEEDING OVER BRIDGE	SPEEDING OVER BRIDGE
S97	SUDDENLY CHNGNG SPD	SUDDENLY CHNGNG SPD
A3361	TOO FAST FOR CONDITIONS	TOO FAST FOR CONDITIONS

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
1002A	TOO FAST FOR CONDITIONS	TOO FAST FOR CONDITIONS
3361	TOO FAST FOR CONDITIONS	TOO FAST FOR CONDITIONS
3365C	TRUCK SPEED ON DOWNGRADES	TRUCK SPEED ON DOWNGRADES

Table E4. Vehicle Violations – Improper Driving (Category 4)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
W41	ADD MAJOR AFTER REINSTATE	ADD MAJOR AFTER REINSTATE
A3742B2	ARD ACCID SERIOUS INJURY	ARD ACCIDENTAL SERIOUS INJURY
A3742B3	ARD ACCID VICTIM DIES	ARD ACCIDENTAL VICTIM DIES
A3714B	ARD-CARELESS DRIV DEATH	ARD-CARELESS DRIVING DEATH
A3714C	ARD-CARELESS DRIV INJURY	ARD-CARELESS DRIVING INJURY
A1041A	ARD-DRAG RACING	ARD-DRAG RACING
A3309.2	ARD-DSRGRD TRAF LN-3LANE	ARD-DISREGARD TRAFFIC LN-3LANE
A3309.4	ARD-DSRGRD TRAF LN-PROHBT	ARD-DISREGARD TRAFFIC LN-PROHBT
A3309.1	ARD-DSRGRD TRAF LN-SNGLE	ARD-DISREGARD TRAFFIC LN-SNGLE
A3733	ARD-FLEE POLICE OFFICER	ARD-FLEE POLICE OFFICER
A3310	ARD-FOLLOWING TOO CLOSELY	ARD-FOLLOWING TOO CLOSELY
A3732	ARD-HOMICIDE BY VEHICLE	ARD-HOMICIDE BY VEHICLE
A3304	ARD-IMPROPER PASSING	ARD-IMPROPER PASSING
A3305	ARD-IMPROPER PASSING	ARD-IMPROPER PASSING
A3306A1	ARD-IMPROPER PASSING	ARD-IMPROPER PASSING
A3306A2	ARD-IMPROPER PASSING	ARD-IMPROPER PASSING
A3306A3	ARD-IMPROPER PASSING	ARD-IMPROPER PASSING
A3307	ARD-IMPROPER PASSING	ARD-IMPROPER PASSING
A3743	ARD-LEAVING SCENE OFACCD.	ARD-LEAVING SCENE OFACCD.
A3745	ARD-LEAVING SCENE OFACCD.	ARD-LEAVING SCENE OFACCD.
A6245	ARD-OPER WITHOUT CONSENT	ARD-OPER WITHOUT CONSENT
A3367	ARD-RACING ON HIGHWAYS	ARD-RACING ON HIGHWAYS
A3736	ARD-RECKLESS DRIVING	ARD-RECKLESS DRIVING
A3342G	ARD-REQ APRCH TRACKS	ARD-REQ APRCH TRACKS
A3717C	ARD-TRESPASS BY MV	ARD-TRESPASS BY MOVING VEHICLE
A3717D	ARD-TRESPASS BY MV	ARD-TRESPASS BY MOVING VEHICLE
A3503B1	ARD-TRESPASSING	ARD-TRESPASSING
A3714	CARELESS DRIVING	CARELESS DRIVING
A3714A	CARELESS DRIVING	CARELESS DRIVING
M80	CARELESS DRIVING	CARELESS DRIVING
3714	CARELESS DRIVING	CARELESS DRIVING
3714A	CARELESS DRIVING	CARELESS DRIVING
3714B	CARELESS DRIVING DEATH	CARELESS DRIVING DEATH
3714C	CARELESS DRIVING INJURY	CARELESS DRIVING INJURY
3736P	CERTIFIED RECKLESS	CERTIFIED RECKLESS
U09	CMV NEGLIGENT HOMICIDE	COMMERCIAL MOTOR VEHICLE NEGLIGENT HOMICIDE
N80	COASTING	COASTING
3503A1	CRIMINAL TRESPASS	CRIMINAL TRESPASS
4107B	DAM/TAMP VEH EQUIP	DAM/TAMP VEHICLE EQUIP
4523B	DEFECT EXHAUST SYSTEM	DEFECT EXHAUST SYSTEM
4107	DEFECTIVE EQUIP	DEFECTIVE EQUIP
A3309.3	DISREGARD TRAFFIC LANE	DISREGARD TRAFFIC LANE
3309.3	DISREGARD TRAFFIC LANE	DISREGARD TRAFFIC LANE
ARD1041	DRAG RACES PROHIBITD1041	DRAG RACES PROHIBITD1041
1041	DRAG RACES PROHIBITED	DRAG RACES PROHIBITED

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
3309	DRIV ON ROAD LANE FOR TRF	DRIVING ON ROAD LANE FOR TRF
1006	DRIVE ON RIGHT SIDE	DRIVE ON RIGHT SIDE
A3546	DRIVE THROUGH SAFETYZONE	DRIVE THROUGH SAFETYZONE
3546	DRIVE THROUGH SAFETYZONE	DRIVE THROUGH SAFETYZONE
A3311	DRIVING ON DIVIDED HWY	DRIVING ON DIVIDED HWY
3311	DRIVING ON DIVIDED HWY	DRIVING ON DIVIDED HWY
A3301	DRIVING RIGHT SIDE ROAD	DRIVING RIGHT SIDE ROAD
3301	DRIVING RIGHT SIDE ROAD	DRIVING RIGHT SIDE ROAD
A3308B	DRIVING WRONG WAY	DRIVING WRONG WAY
3308B	DRIVING WRONG WAY	DRIVING WRONG WAY
A3308C	DRIVING WRONG WAY ROTARY	DRIVING WRONG WAY ROTARY
3308C	DRIVING WRONG WAY ROTARY	DRIVING WRONG WAY ROTARY
3734P	DRV WITHOUT LIGHTS DLCC	DRIVING WITHOUT LIGHTS DRIVERS LICENSECC
3734N	DRV WITHOUT LIGHTS DLCN	DRIVING WITHOUT LIGHTS DRIVERS LICENSECN
D75	DRVNG PHYS/MNTL DIS	DRIVING PHYS/MNTL DIS
D74	DRVNG WHILE DROWSY	DRIVING WHILE DROWSY
3309.2	DSRGRD TRAF LANE-3 LANE	DISREGARD TRAFFIC LANE-3 LANE
3309.4	DSRGRD TRAF LANE-PROHIBIT	DISREGARD TRAFFIC LANE-PROHIBIT
3309.1	DSRGRD TRAF LANE-SINGLE	DISREGARD TRAFFIC LANE-SINGLE
E70	EQUIP USED IMPRPRLY	EQUIPMENT USED IMPRPRLY
M41	FAIL KEEP PROPER LNE	FAILURE KEEP PROPER LNE
4530B	FAIL PLACE RED FLAGS	FAILURE PLACE RED FLAGS
3709B	FAIL RMVE WSTE FR HWY	FAILURE RMVE WSTE FR HWY
501	FAIL TO MANTAIN SECURITY	FAILURE TO MANTAIN SECURITY
M02	FAIL TO OBEY BARRIER	FAILURE TO OBEY BARRIER
1221D	FAIL TO OBEY POLICE	FAILURE TO OBEY POLICE
A3102	FAILURE TO OBEY	FAILURE TO OBEY
3102	FAILURE TO OBEY	FAILURE TO OBEY
U03	FELONY IN A MV	FELONY IN A MOVING VEHICLE
2901	FELONY IN A MV	FELONY IN A MOVING VEHICLE
3121	FELONY IN A MV	FELONY IN A MOVING VEHICLE
3733P	FLEEING POLICE DLCC	FLEEING POLICE DRIVERS LICENSECC
3733N	FLEEING POLICE DLCN	FLEEING POLICE DRIVERS LICENSECN
3733	FLEEING POLICE OFFICER	FLEEING POLICE OFFICER
M32	FOLLOW EMERGENCY VEH	FOLLOW EMERGENCY VEH
M30	FOLLOWING IMPROPERLY	FOLLOWING IMPROPERLY
1010	FOLLOWING TOO CLOSELY	FOLLOWING TOO CLOSELY
1010A	FOLLOWING TOO CLOSELY	FOLLOWING TOO CLOSELY
1010B	FOLLOWING TOO CLOSELY	FOLLOWING TOO CLOSELY
3310	FOLLOWING TOO CLOSELY	FOLLOWING TOO CLOSELY
M05	FTO LANE MARK/SIGNAL	FAILURE TO OBEY LANE MARK/SIGNAL
M11	FTO RESTRICTED LANE	FAILURE TO OBEY RESTRICTED LANE
M09	FTO RR XNG RESTRICT	FAILURE TO OBEY RAILROAD XNG RESTRICT
1602	FTO RULES/REGULATION	FAILURE TO OBEY RULES/REGULATION
E57	FTU SNOW TIRES/CHAIN	FTU SNOW TIRES/CHAIN
N44	GIVING WRONG SIGNAL	GIVING WRONG SIGNAL

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
3711	HANGING ON VEHICLE	HANGING ON VEHICLE
3732P	HOMICIDE BY VEH DLCC	HOMICIDE BY VEHICLE DRIVERS LICENSECC
3732N	HOMICIDE BY VEH DLCN	HOMICIDE BY VEHICLE DRIVERS LICENSECN
3732	HOMICIDE BY VEHICLE	HOMICIDE BY VEHICLE
U21	ILL OPER EMERG VEH	ILLEGAL OPER EMERG VEH
6126	ILLEGAL TRAF CNTL DEV	ILLEGAL TRAFFIC CNTL DEV
A3702	IMPROPER BACKING	IMPROPER BACKING
3702	IMPROPER BACKING	IMPROPER BACKING
M61	IMPROP LN CTR LINE	IMPROPER LANE CTR LINE
M56	IMPROP LN FIRE HOSE	IMPROPER LANE FIRE HOSE
M62	IMPROP LN IN TURN LN	IMPROPER LANE IN TURN LN
M57	IMPROP LN ONCOM TRAF	IMPROPER LANE ONCOM TRAF
M58	IMPROP LN SHLDR/SW	IMPROPER LANE SHLDR/SW
M60	IMPROP LN SLOW VEH	IMPROPER LANE SLOW VEH
A3522	IMPROP MTRCYCLE RIDE	IMPROPER MTRCYCLE RIDE
3522	IMPROP MTRCYCLE RIDE	IMPROPER MTRCYCLE RIDE
M42	IMPROPER LANE CHANGES	IMPROPER LANE CHANGES
1007	IMPROPER OVERTAKING	IMPROPER OVERTAKING
A3303	IMPROPER PASSING	IMPROPER PASSING
M70	IMPROPER PASSING	IMPROPER PASSING
1008A	IMPROPER PASSING	IMPROPER PASSING
1008B	IMPROPER PASSING	IMPROPER PASSING
1008C	IMPROPER PASSING	IMPROPER PASSING
1008E	IMPROPER PASSING	IMPROPER PASSING
3303	IMPROPER PASSING	IMPROPER PASSING
3304	IMPROPER PASSING	IMPROPER PASSING
3305	IMPROPER PASSING	IMPROPER PASSING
3306A1	IMPROPER PASSING	IMPROPER PASSING
3306A2	IMPROPER PASSING	IMPROPER PASSING
3306A3	IMPROPER PASSING	IMPROPER PASSING
3307	IMPROPER PASSING	IMPROPER PASSING
N83	IMPROPER STARTING	IMPROPER STARTING
A3331	IMPROPER TURN	IMPROPER TURN
N50	IMPROPER TURN	IMPROPER TURN
3331	IMPROPER TURN	IMPROPER TURN
A3332	IMPROPER TURNING AROUND	IMPROPER TURNING AROUND
3332	IMPROPER TURNING AROUND	IMPROPER TURNING AROUND
M55	IMPRP LN ON RAIL TRK	IMPRP LANE ON RAIL TRK
D72	INABLTY TO CTRL VEH	INABLTY TO CTRL VEH
3743	LEAVING SCENE OF ACCIDENT	LEAVING SCENE OF ACCIDENT
3709	LITTERING FROM A MV	LITTERING FROM A MOVING VEHICLE
4523C	MAKING EXCESS NOISE	MAKING EXCESS NOISE
M83	NEGLIGENT DRIVING	NEGLIGENT DRIVING
4703	NO EMIS OR VEH INSP	NO EMIS OR VEHICLE INSP
4924	NO WARNG/PRJCTNG LOAD	NO WARNG/PRJCTNG LOAD
3705	OPN VEH DOOR IN MOTION	OPN VEHICLE DOOR IN MOTION
A3304A1	OVERTAKNG VEHCLE ON RIGHT	OVERTAKNG VEHCLE ON RIGHT

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
3304A1	OVERTAKNG VEHCLE ON RIGHT	OVERTAKNG VEHCLE ON RIGHT
1020A	PARKING ON HIGHWAY	PARKING ON HIGHWAY
M77	PASS INSUF DISTANCE	PASS INSUF DISTANCE
M76	PASS WHR PROHIBITED	PASS WHR PROHIBITED
A3719	PASSENGER IN OPEN TRUCK	PASSENGER IN OPEN TRUCK
3719	PASSENGERS IN OPEN TRUCK	PASSENGERS IN OPEN TRUCK
A3345A	PASSING A SCHOOL BUS	PASSING A SCHOOL BUS
3345A	PASSING A SCHOOL BUS	PASSING A SCHOOL BUS
A3327A1	PASSING IN EMERGENCY-AREA	PASSING IN EMERGENCY-AREA
3327A1	PASSING IN EMERGENCY-AREA	PASSING IN EMERGENCY-AREA
1018	PASSING SCHOOL BUS	PASSING SCHOOL BUS
M74	PASSNG ON HILL/CURVE	PASSNG ON HILL/CURVE
M73	PASSNG ON WRONG SIDE	PASSNG ON WRONG SIDE
D78	PERJURY IN OPER MV	PERJURY IN OPER MOVING VEHICLE
3367	RACING ON HIGHWAYS	RACING ON HIGHWAYS
M43	RAN OFF ROAD	RAN OFF ROAD
1001	RECKLESS DRIVING	RECKLESS DRIVING
10011	RECKLESS DRIVING	RECKLESS DRIVING
1011B	RECKLESS DRIVING	RECKLESS DRIVING
1011D	RECKLESS DRIVING	RECKLESS DRIVING
3714Z	RECKLESS DRIVING	RECKLESS DRIVING
3736	RECKLESS DRIVING	RECKLESS DRIVING
3736N	RECKLESS DRIVING DLCN	RECKLESS DRIVING DRIVERS LICENSECN
4903	SECURING LOADS ON VEH	SECURING LOADS ON VEH
W52	THREE OR MORE OOSO HZ VIO	THREE OR MORE OOSO HAZMAT VIO
W61	THREE OR MORE RRGC VIOLS	THREE OR MORE RAILROADGC VIOLS
W31	THREE STO WITHIN 3 YEARS	THREE STO WITHIN 3 YEARS
A3707	TOO CLOSE EMERG VEH	TOO CLOSE EMERG VEH
3707	TOO CLOSE EMERG VEH	TOO CLOSE EMERG VEH
4905	TOW/PUSH VEH IMPROPER	TOW/PUSH VEHICLE IMPROPER
A3111	TRAFFIC-CNTROL VIOL	TRAFFIC-CNTROL VIOL
3111	TRAFFIC-CNTROL VIOL	TRAFFIC-CNTROL VIOL
3717C	TRESPASS BY MOTOR VEHICLE	TRESPASS BY MOTOR VEHICLE
3717D	TRESPASS BY MOTOR VEHICLE	TRESPASS BY MOTOR VEHICLE
3503B1	TRESPASSING	TRESPASSING
3717	TRESSPASS BY MV	TRESSPASS BY MOVING VEHICLE
W40	TWO OR MORE MAJORS	TWO OR MORE MAJORS
W51	TWO OR MORE OOSO HZ VIOLS	TWO OR MORE OOSO HAZMAT VIOLS
W50	TWO OR MORE OOSO VIOLS	TWO OR MORE OOSO VIOLS
W30	TWO STO WITHIN 3 YEARS	TWO STO WITHIN 3 YEARS
1028B4	U TURN VIOLATION	U TURN VIOLATION
4571	UNAUTH USE OF LIGHTSEM	UNAUTH USE OF LIGHTSEM
E23	UNAUTH USE OF RADAR	UNAUTH USE OF RADAR
N84	UNSAFE OPERATION	UNSAFE OPERATION
4103	VEH EQUIP STANDARDS	VEHICLE EQUIPMENT STANDARDS
U06	VEHICULAR ASSAULT	VEHICULAR ASSAULT
M71	VIOL NO PASSING ZONE	VIOLATION NO PASSING ZONE

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
M72	VIOL OPPOS DIR RESTR	VIOLATION OPPOS DIR RESTR
U31	VIOL RESULTING IN FATALTY	VIOLATION RESULTING IN FATALTY
3742	ACCID INV DEATH OR INJURY	ACCIDENTAL INVOLUNTARY DEATH OR INJURY
3742A	ACCID INV DEATH OR INJURY	ACCIDENTAL INVOLUNTARY DEATH OR INJURY
3742B1	ACCID INV DEATH OR INJURY	ACCIDENTAL INVOLUNTARY DEATH OR INJURY
3742B2	ACCID SERIOUS BDLY INJURY	ACCIDENTAL SERIOUS BODILY INJURY
3742B3	ACCID VICTIM DIES	ACCIDENTAL VICTIM DIES
W01	ACCUM CONVICTIONS	ACCUM CONVICTIONS
2702A1	AGGRAVATED ASSAULT	AGGRAVATED ASSAULT
2702A4	AGGRAVATED ASSAULT	AGGRAVATED ASSAULT
2702A2	AGGRAVATED ASSAULT-POLICE	AGGRAVATED ASSAULT-POLICE
626	ALLOW UNAUTH USE OF VEHIC	ALLOW UNAUTH USE OF VEHIC
A3742	ARD ACC INV DEATH/INJURY	ARD ACCIDENTAL INVOLUNTARY DEATH/INJURY
A3742A	ARD ACC INV DEATH/INJURY	ARD ACCIDENTAL INVOLUNTARY DEATH/INJURY
A3742B1	ARD ACC INV DEATH/INJURY	ARD ACCIDENTAL INVOLUNTARY DEATH/INJURY
A2702A1	ARD-AGGRAVATED ASSAULT	ARD-AGGRAVATED ASSAULT
A2702A2	ARD-AGGRAVATED ASSAULT	ARD-AGGRAVATED ASSAULT
A2702A4	ARD-AGGRAVATED ASSAULT	ARD-AGGRAVATED ASSAULT
A1038	ARD-DRIVE WITHOUT LIGHTS	ARD-DRIVE WITHOUT LIGHTS
A3734	ARD-DRIVE WITHOUT LIGHTS	ARD-DRIVE WITHOUT LIGHTS
A2504	ARD-INVOLUNTARY MANSLGHTR	ARD-INVOLUNTARY MANSLGHTR
A2502	ARD-MURDER	ARD-MURDER
A2705	ARD-RECKLESS ENDANGERMNT	ARD-RECKLESS ENDANGERMNT
A2503	ARD-VOLUNTARY MANSLAUGHTR	ARD-VOLUNTARY MANSLAUGHTR
901	CRIMINAL ATTEMPT	CRIMINAL ATTEMPT
903	CRIMINAL CONSPIRACY	CRIMINAL CONSPIRACY
2501	CRIMINAL HOMICIDE	CRIMINAL HOMICIDE
ARD3304	CRIMINAL MISCHIEF	CRIMINAL MISCHIEF
3304M	CRIMINAL MISCHIEF	CRIMINAL MISCHIEF
1038	DRIVING WITHOUT LIGHTS	DRIVING WITHOUT LIGHTS
3734	DRIVING WITHOUT LIGHTS	DRIVING WITHOUT LIGHTS
3326	DUTY OF DRVR IN CONSTAREA	DUTY OF DRVR IN CONSTAREA
N41	FAIL CANC DIR SIGNAL	FAILURE CANC DIR SIGNAL
N42	FAIL SIGNL INTNT PSS	FAILURE SIGNL INTNT PSS
A4302	FAIL TO USE LIGHTS	FAILURE TO USE LIGHTS
4302	FAIL TO USE LIGHTS	FAILURE TO USE LIGHTS
E50	FAIL USE EQUIP AS RQ	FAILURE USE EQUIPMENT AS RQ
4305	FAIL USE HAZ EQUIP	FAILURE USE HAZ EQUIP
U10	FATALTY-NEGLIGNT CMVOPER	FATALTY-NEGLIGNT CMVOPER
A8306	HAZMAT VIOLATION	HAZMAT VIOLATION

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
8306	HAZMAT VIOLATION	HAZMAT VIOLATION
A4306	IMP HIGH BEAMS	IMPROPER HIGH BEAMS
4306	IMP HIGH BEAMS	IMPROPER HIGH BEAMS
M47	IMPROP LANE BICYCLE	IMPROPER LANE BICYCLE
M44	IMPROP LANE CROSSOVR	IMPROPER LANE CROSSOVR
M45	IMPROP LANE CROSSWLK	IMPROPER LANE CROSSWLK
M46	IMPROP LANE ENT/EXIT	IMPROPER LANE ENT/EXIT
M49	IMPROP LANE HOV RSTR	IMPROPER LANE HOV RSTR
M50	IMPROP LANE LIM ACCS	IMPROPER LANE LIM ACCS
M51	IMPROP LANE MEDIAN	IMPROPER LANE MEDIAN
M48	IMPROP LANE OCCUPIED	IMPROPER LANE OCCUPIED
M40	IMPROP LANE OR LOCAT	IMPROPER LANE OR LOCAT
A3525	IMPROP MTRCYCLE EQUIP	IMPROPER MTRCYCLE EQUIP
3525	IMPROP MTRCYCLE EQUIP	IMPROPER MTRCYCLE EQUIP
A4107B2	IMPROPER EQUIPMENT	IMPROPER EQUIPMENT
4107B2	IMPROPER EQUIPMENT	IMPROPER EQUIPMENT
A4525	IMPROPER TIRES	IMPROPER TIRES
4525	IMPROPER TIRES	IMPROPER TIRES
A3334	IMPROPER TURN SIGNAL	IMPROPER TURN SIGNAL
3334	IMPROPER TURN SIGNAL	IMPROPER TURN SIGNAL
M82	INATTENTIVE DRVG	INATTENTIVE DRVG
2504	INVOLUNTARY MANSLAUGHTER	INVOLUNTARY MANSLAUGHTER
U04	MISDEMEANOR IN A MV	MISDEMEANOR IN A MOVING VEHICLE
2502	MURDER	MURDER
A4502	OPER W/O BRAKES	OPER W/O BRAKES
4502	OPER W/O BRAKES	OPER W/O BRAKES
A4303	OPERAT W/O LIGHTS	OPERAT W/O LIGHTS
4303	OPERAT W/O LIGHTS	OPERAT W/O LIGHTS
1575	PERMITTING VIOLATION	PERMITTING VIOLATION
2705	RECKLESS ENDANGERMENT	RECKLESS ENDANGERMENT
2701	SIMPLE ASSAULT	SIMPLE ASSAULT
3928	UNAUTHORIZED USE OF AUTO	UNAUTHORIZED USE OF AUTO
F66	UNSAFE COND OF VEHCL	UNSAFE COND OF VEHCL
4945	VIO SZ/WGT/PASS LIMIT	VIO SZ/WGT/PASS LIMIT
4923	VIOL SIZE LIMITS	VIOLATION SIZE LIMITS
2503	VOLUNTARY MANSLAUGHTER	VOLUNTARY MANSLAUGHTER
4981	WEIGHT VIOLATION	WEIGHT VIOLATION
A4524	WINDSHIELD OR WIPERS	WINDSHIELD OR WIPERS
4524	WINDSHIELD OR WIPERS	WINDSHIELD OR WIPERS

Table E5. Vehicle Violations – DUI (Category 5)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
A94	ADM PER SE .04 BAC	ADM PER SE .04 BAC
A98	ADM PER SE .08 BAC	ADM PER SE .08 BAC
A90	ADM PER SE .10 BAC	ADM PER SE .10 BAC
3735.1	AGGR ASSAULT BY VEH DUI	AGGRAVATED ASSAULT BY VEHICLE DUI
A3735.1	ARD AGGR ASSLT BY VEH-DUI	ARD AGGRAVATED ASSLT BY VEH-DUI
A3735	ARD HOMICIDE BY VEH-DUI	ARD HOMICIDE BY VEH-DUI
A1037	ARD-DUI	ARD-DUI
A3731	ARD-DUI	ARD-DUI
A3731I	ARD-DUI	ARD-DUI
A3802A2	ARD-DUI BAC .08-<.10	ARD-DUI BAC .08-<.10
A3802B	ARD-DUI BAC .10-<.16	ARD-DUI BAC .10-<.16
A3802C	ARD-DUI BAC .16+	ARD-DUI BAC .16+
A3802F4	ARD-DUI CMV ALC AND DRGS	ARD-DUI COMMERCIAL MOTOR VEHICLE ALC AND DRGS
A3802F1I	ARD-DUI CMV BAC .04+	ARD-DUI COMMERCIAL MOTOR VEHICLE BAC .04+
A3802F3	ARD-DUI CMV DRUGS	ARD-DUI COMMERCIAL MOTOR VEHICLE DRUGS
A3802F2	ARD-DUI CMV INCAP SAFE OP	ARD-DUI COMMERCIAL MOTOR VEHICLE INCAP SAFE OP
A3802F	ARD-DUI CMV OR SCHOOL VEH	ARD-DUI COMMERCIAL MOTOR VEHICLE OR SCHOOL VEH
A3802D	ARD-DUI CONTROLLED SUBST	ARD-DUI CONTROLLED SUBST
A3802A1	ARD-DUI GEN IMPAIRMENT	ARD-DUI GEN IMPAIRMENT
A3802E	ARD-DUI MINOR	ARD-DUI MINOR
A3802F12	ARD-DUI SCH VEH BAC-.02+	ARD-DUI SCH VEHICLE BAC-.02+
P613	CHEMICAL TEST REFUSAL	CHEMICAL TEST REFUSAL
1547	CHEMICAL TEST REFUSAL	CHEMICAL TEST REFUSAL
1613	CHEMICAL TEST REFUSAL	CHEMICAL TEST REFUSAL
6241A	CHEMICAL TEST REFUSAL	CHEMICAL TEST REFUSAL
A26	DRINKING WHILE DRVNG	DRINKING WHILE DRVNG
3731I	DRIV UNDER INFLUENCE-CMV	DRIVING UNDER INFLUENCE-CMV
1037	DRIVING UNDER INFLUENCE	DRIVING UNDER INFLUENCE
3731	DRIVING UNDER INFLUENCE	DRIVING UNDER INFLUENCE
3731P	DRV UNDER INFLUE DLCC	DRIVING UNDER INFLUE DRIVERS LICENSECC
3731N	DRV UNDER INFLUE DLCN	DRIVING UNDER INFLUE DRIVERS LICENSECN
A25	DRVNG WHILE IMPAIRED	DRIVING WHILE IMPAIRED
3802A2	DUI BAC .08-<.10	DUI BAC .08-<.10
3802B	DUI BAC .10-<.16	DUI BAC .10-<.16
3802C	DUI BAC .16+	DUI BAC .16+
3802F	DUI CMV OR SCHOOL VEHICLE	DUI COMMERCIAL MOTOR VEHICLE OR SCHOOL VEHICLE
3802D	DUI CONTROLLED SUBSTANCES	DUI CONTROLLED SUBSTANCES
3802A1	DUI GENERAL IMPAIRMENT	DUI GENERAL IMPAIRMENT
3802E	DUI MINOR	DUI MINOR
A24	DUI OF MEDICATION	DUI OF MEDICATION

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
3802F4	DUI-CMV ALCOHOL AND DRUGS	DUI-COMMERCIAL MOTOR VEHICLE ALCOHOL AND DRUGS
3802F1I	DUI-CMV BAC .04+	DUI-COMMERCIAL MOTOR VEHICLE BAC .04+
3802F3	DUI-CMV DRUGS	DUI-COMMERCIAL MOTOR VEHICLE DRUGS
3802F2	DUI-CMV INCAP SAFE OPER	DUI-COMMERCIAL MOTOR VEHICLE INCAP SAFE OPER
3802F1II	DUI-SCH VEH BAC .02+	DUI-SCH VEHICLE BAC .02+
3735P	HOM BY VEH-DUI DLCC	HOMICIDE BY VEH-DUI DRIVERS LICENSECC
3735N	HOM BY VEH-DUI DLCN	HOMICIDE BY VEH-DUI DRIVERS LICENSECN
3735	HOMICIDE BY VEHICLE-DUI	HOMICIDE BY VEHICLE-DUI
1547B.1	OTHER CHEM TEST REFUSAL	OTHER CHEM TEST REFUSAL
A61	UA A-P-S DUI => .02	UA A-P-S DUI => .02
A3808A2	ARD-DRVNG WO II-ALC/DRUG	ARD-DRIVING WO II-ALC/DRUG
3808A2	DRIVING W/O II - ALC/DRUG	DRIVING W/O II - ALC/DRUG

Table E6. Vehicle Violations – Failure to Respond (Category 6)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
1533D	FAIL TO RESPOND	FAILURE TO RESPOND
618B6	FAIL TO RESPOND TO CITAT	FAILURE TO RESPOND TO CITAT
1533	FAILURE TO RESPOND	FAILURE TO RESPOND
1533A	FAILURE TO RESPOND	FAILURE TO RESPOND
1745C	DEFAULT IN JUDGMENT PAY	DEFAULT IN JUDGMENT PAY
1775C	DEFAULT IN JUDGMENT PAY	DEFAULT IN JUDGMENT PAY
1533B	ENFORCEMENT AGREEMNT-NRVC	ENFORCEMENT AGREEMNT-NRVC
D45	FAIL APPEAR FOR TRIAL	FAILURE APPEAR FOR TRIAL
D37	FAIL PAY DAMAGES	FAILURE PAY DAMAGES
D56	FAIL TO ANSWER	FAILURE TO ANSWER
D53	FAIL TO PAY FINE/COST	FAILURE TO PAY FINE/COST
1413	NONPAYMENT OF JUDGMENT	NONPAYMENT OF JUDGMENT
1742	NONPAYMENT OF JUDGMENT	NONPAYMENT OF JUDGMENT
1772	NONPAYMENT OF JUDGMENT	NONPAYMENT OF JUDGMENT

Table E7. Vehicle Violations – Other (Category 7)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
3712	ABANDONED VEHICLE	ABANDONED VEHICLE
5107	AID CONSUMATION OF CRIME	AID CONSUMATION OF CRIME
U05	AIDING/ABETING FELON	AIDING/ABETING FELON
7122	ALTERED DOCUMENTS/PLATES	ALTERED DOCUMENTUMENTS/PLATES
A5107	ARD-AIDING CRIME	ARD-AIDING CRIME
A7122	ARD-ALTERED DOCS/PLATES	ARD-ALTERED DOCUMENTS/PLATES
AC3301	ARD-ARSON/RELAT OFFENSES	ARD-ARSON/RELAT OFFENSES
A4701	ARD-BRIBERY	ARD-BRIBERY
A3502	ARD-BURGLARY	ARD-BURGLARY
A4106	ARD-CREDIT CARD FRAUD	ARD-CREDIT CARD FRAUD
A7512A	ARD-CRIM USE-COMM FACILTY	ARD-CRIM USE-COMM FACILTY
A901	ARD-CRIMINAL ATTEMPT	ARD-CRIMINAL ATTEMPT
A903	ARD-CRIMINAL CONSPIRACY	ARD-CRIMINAL CONSPIRACY
A2501	ARD-CRIMINAL HOMICIDE	ARD-CRIMINAL HOMICIDE
A3304M	ARD-CRIMINAL MISCHIEF	ARD-CRIMINAL MISCHIEF
A902	ARD-CRIMINAL SOLICITATION	ARD-CRIMINAL SOLICITATION
A3503A1	ARD-CRIMINAL TRESPASS	ARD-CRIMINAL TRESPASS
A7111	ARD-DEAL IN TITLES/PLATES	ARD-DEAL IN TITLES/PLATES
A5121	ARD-ESCAPE	ARD-ESCAPE
A1027B	ARD-FAIL TO IDENTIFY	ARD-FAILURE TO IDENTIFY
A7121	ARD-FALSE APPLICATION	ARD-FALSE APPLICATION
A6106A	ARD-FIREARM VIOLATION	ARD-FIREARM VIOLATION
A4101	ARD-FORGERY	ARD-FORGERY
A4101A	ARD-FORGERY	ARD-FORGERY
A905	ARD-GRADE OF CIM ATTEMPT	ARD-GRADE OF CIM ATTEMPT
A5105	ARD-HINDER APPREHENSION	ARD-HINDER APPREHENSION
A304	ARD-IGNORANCE OR MISTAKE	ARD-IGNORANCE OR MISTAKE
A4117A	ARD-INSURANCE FRAUD	ARD-INSURANCE FRAUD
A3123	ARD-INVOL DEV SEX INTCRSE	ARD-INVOL DEV SEX INTCRSE
A2901	ARD-KIDNAPPING	ARD-KIDNAPPING
A211A	ARD-MAKE FRAUDULENT DOCS	ARD-MAKE FRAUDULENT DOCUMENTS
A6106	ARD-NO FIREARM IN ANY VEH	ARD-NO FIREARM IN ANY VEH
A3121	ARD-RAPE	ARD-RAPE
A7102B	ARD-REMOVAL OF IDENTIF	ARD-REMOVAL OF IDENTIF
A301	ARD-REQ OF VOLUNTARYACT	ARD-REQ OF VOLUNTARYACT
A5104	ARD-RESISTING ARREST	ARD-RESISTING ARREST
A3701	ARD-ROBBERY	ARD-ROBBERY
A3702A	ARD-ROBBERY OF A MV	ARD-ROBBERY OF A MOVING VEHICLE
A3755	ARD-RPTS/EMERGENCY PERSON	ARD-RPTS/EMERGENCY PERSON
A2701	ARD-SIMPLE ASSAULT	ARD-SIMPLE ASSAULT
A3928	ARD-UNAUTH USE OF AUTO	ARD-UNAUTH USE OF AUTO
A7103B	ARD-VEH WITH FALSE #'S	ARD-VEHICLE WITH FALSE #'S
C3301	ARSON/RELAED OFFENSES	ARSON/RELAED OFFENSES
4701	BRIBERY-OFFICIAL MATTERS	BRIBERY-OFFICIAL MATTERS
3502	BURGLARY	BURGLARY
A63103	CARRYING A FALSE ID CARD	CARRYING A FALSE ID CARD
D63103	CARRYING A FALSE ID CARD	CARRYING A FALSE ID CARD

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
6310	CARRYING A FALSE ID CARD	CARRYING A FALSE ID CARD
63103	CARRYING A FALSE ID CARD	CARRYING A FALSE ID CARD
CERT	CERTIFY OOS CONVICTION	CERTIFY OOS CONVICTION
7512A	CRIMINAL USE-COM FACILITY	CRIMINAL USE-COM FACILITY
902	CRMINAL SOLICITATION	CRMINAL SOLICITATION
7111	DEALING IN TITLES/PLATES	DEALING IN TITLES/PLATES
3744	DUTY TO GIVE INFO/AID	DUTY TO GIVE INFO/AID
4531	EMISSION CONTRL SYS	EMISSION CONTRL SYS
6146	ENFORCEMENT AGREEMENTS	ENFORCEMENT AGREEMENTS
5121	ESCAPE	ESCAPE
1571A3	EXHIBIT ANOTHER DL	EXHIBIT ANOTHER DRIVERS LICENSE
1301	EXPIRED REG OR DOC	EXPIRED REGISTRATION OR DOCUMENT
1301D	EXPIRED REG OR DOC	EXPIRED REGISTRATION OR DOCUMENT
D35	FAIL COMPLY W/FR LAW	FAILURE COMPLY W/FR LAW
D38	FAIL PST SEC/OBT REL	FAILURE PST SEC/OBT REL
A3747	FAIL TO FILE ACCIDENT RPT	FAILURE TO FILE ACCIDENT RPT
3747	FAIL TO FILE ACCIDENT RPT	FAILURE TO FILE ACCIDENT RPT
B14	FAIL TO ID POST ACCD	FAILURE TO ID POST ACCD
1027B	FAIL TO IDENTIFY-ACCIDENT	FAILURE TO IDENTIFY-ACCIDENT
1417	FAIL TO MAINTAIN FR	FAILURE TO MAINTAIN FR
9013	FAIL TO PAY TAX	FAILURE TO PAY TAX
6110	FAIL TO PAY TOLL	FAILURE TO PAY TOLL
A1786C	FAIL TO PROV FIN RESP	FAILURE TO PROV FIN RESP
A1786F	FAIL TO PROV FR DLC P	FAILURE TO PROV FR DRIVERS LICENSEC P
A1786E	FAIL TO PROV FR INS P	FAILURE TO PROV FR INS P
1785	FAIL TO PROVIDE FR-ACCID	FAILURE TO PROVIDE FR-ACCID
1786G	FAIL TO PROVIDE FR-ARS	FAILURE TO PROVIDE FR-ARS
1786F	FAIL TO PROVIDE FR-DLC	FAILURE TO PROVIDE FR-DLC
1786E	FAIL TO PROVIDE FR-INS	FAILURE TO PROVIDE FR-INS
1786C	FAIL TO PROVIDE FR-SAMP	FAILURE TO PROVIDE FR-SAMP
1784	FAIL TO PROVIDE FR-VIOL	FAILURE TO PROVIDE FR-VIOL
7101	FAILED TO GET VIN	FAILED TO GET VIN
1571A4	FAILED TO SUR DOC	FAILED TO SUR DOCUMENT
88.3B	FAILURE TO ADD ADDL VEH	FAILURE TO ADD ADDRIVERS LICENSE VEH
3748	FALSE ACCIDENT REPORT	FALSE ACCIDENT REPORT
7121	FALSE APPLICATION	FALSE APPLICATION
1604D	FALSE REPORT	FALSE REPORT
4730	FALSE VEH INSPEC REPORT	FALSE VEHICLE INSPEC REPORT
A50H	FELONY-MFR/DLVY/POSS	FELONY-MFR/DLVY/POSS
6106A	FIREARM NOT TO BE CARRIED	FIREARM NOT TO BE CARRIED
4101	FORGERY	FORGERY
4101A	FORGERY	FORGERY
B63	FR NOT FILED	FR NOT FILED
7124	FRAUD USE OF REG PLT/TTL	FRAUD USE OF REGISTRATION PLT/TTL
905	GRADE OF CRIMINAL ATTEMPT	GRADE OF CRIMINAL ATTEMPT
5105	HINDERING APPREHENSION	HINDERING APPREHENSION

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
304	IGNORANCE OR MISTAKE	IGNORANCE OR MISTAKE
4117A	INSURANCE FRAUD	INSURANCE FRAUD
3123	INVOL DEV SEX INTERCOURSE	INVOL DEV SEX INTERCOURSE
1571A.1	ISSUING FALSE ID	ISSUING FALSE ID
3745	LEAVING SCENE OF ACCIDENT	LEAVING SCENE OF ACCIDENT
1571A2	LENDING DL TO OTHERS	LENDING DRIVERS LICENSE TO OTHERS
1372	LOAN REG/PLATES	LOAN REG/PLATES
D10	MAKE FALSE ID/DL	MAKE FALSE ID/DL
211A	MAKE FRAUDULENT DOCUMENTS	MAKE FRAUDULENT DOCUMENTUMENTS
CDLMISC	MISC CDLIS CONVICTION	MISC CDLIS CONVICTION
MISSING	MISSING VIOL FROM COURT	MISSING VIOLATION FROM COURT
1332	MISSNG/DEFACE LIC PLT	MISSNG/DEFACE LIC PLT
D02	MSREP OF ID ON DL AP	MSREP OF ID ON DRIVERS LICENSE AP
1513	MUTILATED DL DOC	MUTILATED DRIVERS LICENSE DOCUMENT
1313	MUTILATED VR DOC	MUTILATED VR DOCUMENT
1511	NO DOCS SHOWN	NO DOCUMENTS SHOWN
6106	NO FIREARM IN ANY VEHICLE	NO FIREARM IN ANY VEHICLE
B64	NO INS CERT FILED	NO INS CERT FILED
B65	NO MED CERT/DISB INF	NO MED CERT/DISB INF
1311	NO REGISTRATION SHOWN	NO REGISTRATION SHOWN
4907	NO REQ DOCS SHOWN	NO REQ DOCUMENTS SHOWN
1334	NO SUR OF DOCUMENT	NO SUR OF DOCUMENTUMENT
7132	ODOMETER TAMPERING	ODOMETER TAMPERING
6245	OPERATE WITHOUT CONSENT	OPERATE WITHOUT CONSENT
OOSW	OUT OF STATE WITHDRAWAL	OUT OF STATE WITHDRAWAL
4902	PERJURY	PERJURY
211B	POSSESS FORGING EQUIPMENT	POSSESS FORGING EQUIPMENT
A3353	PROHIBIT SPECIFIC PLACES	PROHIBIT SPECIFIC PLACES
3353	PROHIBIT SPECIFIC PLACES	PROHIBIT SPECIFIC PLACES
7102	REML/FALS OF ID NUM	REML/FALS OF ID NUM
7102B	REMOVAL OF IDENTIFICATION	REMOVAL OF IDENTIFICATION
1604	REQ DOCS NOT FILED	REQ DOCUMENTS NOT FILED
301	REQRMNT OF VOLUNTARYACT	REQRMNT OF VOLUNTARYACT
1216	RESISTING ARREST	RESISTING ARREST
5104	RESISTING ARREST	RESISTING ARREST
1960	RESTORATION CANCELLATION	RESTORATION CANCELLATION
3701	ROBBERY	ROBBERY
3702A	ROBBERY OF A MTR VEHCL	ROBBERY OF A MTR VEHCL
A4581	SEATBELT VIOLATION	SEATBELT VIOLATION
4581	SEATBELT VIOLATION	SEATBELT VIOLATION
4581A3	SEATBELT VIOLATION	SEATBELT VIOLATION
6243	TO DISPLAY ANOTHER'SLIC	TO DISPLAY ANOTHER'SLIC
6242	TO LEND OPERATOR LICENSE	TO LEND OPERATOR LICENSE
1111	TRANSFER OF VEHICLE	TRANSFER OF VEHICLE
3921	VEHICLE THEFT	VEHICLE THEFT
7103B	VEHICLES WITH FALSE NUMBS	VEHICLES WITH FALSE NUMBS
6244	REFUSAL TO SURRENDER	REFUSAL TO SURRENDER

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
A4552	SCHOOL BUS MARKINGS	SCHOOL BUS MARKINGS
4552	SCHOOL BUS MARKINGS	SCHOOL BUS MARKINGS
A3809	POSS OPEN CONTAINER	POSS OPEN CONTAINER
3809	POSS OPEN CONTAINER	POSS OPEN CONTAINER

Table E8. Vehicle Violations – Non-Highway Safety (Category 8)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
13A12X	ACQ/OBT/POSS-CTRL SUB	ACQ/OBT/POSS-CTRL SUB
A13A1	ARD - M/S/P/D ALTERED SUB	ARD - M/S/P/D ALTERED SUB
A3927A	ARD THEFT-REQUIRE	ARD THEFT-REQUIRE
A3903A	ARD-GRADING OF THEFT	ARD-GRADING OF THEFT
A13A14	ARD-IMPRP ADM/DISP PRESCP	ARD-IMPRP ADM/DISP PRESCP
A13A36	ARD-M/D/P DESIGNER DRUG	ARD-M/D/P DESIGNER DRUG
A13A30	ARD-MFR/DLVY/POSS-CTL SUB	ARD-MFR/DLVY/POSS-CTL SUB
A3718	ARD-MINOR ALCOHOL	ARD-MINOR ALCOHOL
A13A12	ARD-POSS BY FRAUD	ARD-POSS BY FRAUD
A13A31	ARD-POSS OF MARIJUANA	ARD-POSS OF MARIJUANA
A13A19	ARD-PURCHASE CTRL SYBS	ARD-PURCHASE CTRL SYBS
A3925	ARD-RECEIVE STOLEN PROP	ARD-RECEIVE STOLEN PROP
A13A10	ARD-RETAIL SALE CTRLSUBS	ARD-RETAIL SALE CTRLSUBS
A3929	ARD-RETAIL THEFT	ARD-RETAIL THEFT
A2706	ARD-TERRORISTIC THREATS	ARD-TERRORISTIC THREATS
A3922	ARD-THEFT BY DECEPTION	ARD-THEFT BY DECEPTION
A3923	ARD-THEFT BY EXTORTION	ARD-THEFT BY EXTORTION
A3926	ARD-THEFT OF SERVICES	ARD-THEFT OF SERVICES
A3921A	ARD-THEFT/UNLAWFUL TAKING	ARD-THEFT/UNLAWFUL TAKING
A3921B	ARD-THEFT/UNLAWFUL TAKING	ARD-THEFT/UNLAWFUL TAKING
A3932A	ARD-THEFT-LEASED PROP	ARD-THEFT-LEASED PROP
A13A16	ARD-UNAUTH POSS-CTRLSUB	ARD-UNAUTH POSS-CTRLSUB
4355	CHILD ENFORCEMENT	CHILD ENFORCEMENT
4355D	CHILD ENFORCEMENT	CHILD ENFORCEMENT
13A12	CONTROL SUBSTANCE OFFENSE	CONTROL SUBSTANCE OFFENSE
13A12A	CONTROL SUBSTANCE OFFENSE	CONTROL SUBSTANCE OFFENSE
13A30	DELIVERY OF CTRL SUB	DELIVERY OF CTRL SUB
13A30A	DELIVERY OF CTRL SUB	DELIVERY OF CTRL SUB
13A30X	DELIVERY OF CTRL SUB	DELIVERY OF CTRL SUB
7112	FALSE REPORT OF THEFT	FALSE REPORT OF THEFT
A50	FELONY-MFR/DLVY/POSS-DRUG	FELONY-MFR/DLVY/POSS-DRUG
3903A	GRADING OF THEFT OFFENSES	GRADING OF THEFT OFFENSES
13A30H	MFR/DELIVERY-CTRL SUBS	MFR/DELIVERY-CTRL SUBS
13A30C	MFR/DLVY/POSS-CRTL SUBS	MFR/DLVY/POSS-CRTL SUBS
13A30M	MFR/DLVY/POSS-CTRL SUBS	MFR/DLVY/POSS-CTRL SUBS
13A36	MFR/DSTR/POSS-DESGN DRUG	MFR/DSTR/POSS-DESGN DRUG
13A36A	MFR/DSTR/POSS-DESGN DRUG	MFR/DSTR/POSS-DESGN DRUG
13A36H	MFR/DSTR/POSS-DESGN DRUG	MFR/DSTR/POSS-DESGN DRUG
13A36X	MFR/DSTR/POSS-DESGN DRUG	MFR/DSTR/POSS-DESGN DRUG
13A1H	MFR/SALE/POSS-ALTED SUB	MFR/SALE/POSS-ALTED SUB
3718	MINOR ALCOHOL OFFENSE	MINOR ALCOHOL OFFENSE
13A12H	POSS BY FRAUD - CTRLSUBS	POSS BY FRAUD - CTRLSUBS
13A12M	POSS BY FRAUD-CTRL SUBS	POSS BY FRAUD-CTRL SUBS
211C	POSSESS/SELL STOLEN DOCS	POSSESS/SELL STOLEN DOCUMENTS
13A16	POSSESSION OF CTRL SUB	POSSESSION OF CTRL SUB
13A16A	POSSESSION OF CTRL SUB	POSSESSION OF CTRL SUB
13A16X	POSSESSION OF CTRLS UB	POSSESSION OF CTRLS UB

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
13A31	POSSESSION OF MARIJUANA	POSSESSION OF MARIJUANA
13A31A	POSSESSION OF MARIJUANA	POSSESSION OF MARIJUANA
13A31H	POSSESSION OF MARIJUANA	POSSESSION OF MARIJUANA
13A31X	POSSESSION OF MARIJUANA	POSSESSION OF MARIJUANA
13A19	PURCHASE-CTRL SUBS	PURCHASE-CTRL SUBS
13A19A	PURCHASE-CTRL SUBS	PURCHASE-CTRL SUBS
3925	RECEIVE STOLEN PROPERTY	RECEIVE STOLEN PROPERTY
13A10	RETAIL SALE-CTRL SUBS	RETAIL SALE-CTRL SUBS
13A10A	RETAIL SALE-CTRL SUBS	RETAIL SALE-CTRL SUBS
3929	RETAIL THEFT	RETAIL THEFT
616A4	REVOCATION-DRUG VIOLATION	REVOCATION-DRUG VIOLATION
2706	TERRORISTIC THREATS	TERRORISTIC THREATS
3922	THEFT BY DECEPTION	THEFT BY DECEPTION
3923	THEFT BY EXTORTION	THEFT BY EXTORTION
3921A	THEFT BY UNLAWFUL TAKING	THEFT BY UNLAWFUL TAKING
3921B	THEFT BY UNLAWFUL TAKING	THEFT BY UNLAWFUL TAKING
3926	THEFT OF SERVICES	THEFT OF SERVICES
3932A	THEFT-LEASED PROP	THEFT-LEASED PROP
3927A	THEFT-REQUIRED DISPOSITN	THEFT-REQUIRED DISPOSITN
1333	TRUANCY VIOL	TRUANCY VIOL
13A16H	UNAUTH POSS OF CTRL SUB	UNAUTH POSS OF CTRL SUB
A6308	UNDERAGE ALCOHOL OFFENSE	UNDERAGE ALCOHOL OFFENSE
D6308	UNDERAGE ALCOHOL OFFENSE	UNDERAGE ALCOHOL OFFENSE
6308	UNDERAGE ALCOHOL OFFENSE	UNDERAGE ALCOHOL OFFENSE
A6307	UNDERAGE ALCOHOL PURCHASE	UNDERAGE ALCOHOL PURCHASE
D6307	UNDERAGE ALCOHOL PURCHASE	UNDERAGE ALCOHOL PURCHASE
6307	UNDERAGE ALCOHOL PURCHASE	UNDERAGE ALCOHOL PURCHASE
807	BURGLERY/SUSP/REVO	BURGLERY/SUSP/REVO
1571A1	VIOLS CONCERNING LICENSES	VIOLS CONCERNING LICENSES
1571A5	VIOLS CONCERNING LICENSES	VIOLS CONCERNING LICENSES
1503C3	JR DRIVER SUSPENSION	JR DRIVER SUSPENSION
1515	FAILED TO CHG ADDRESS	FAILED TO CHG ADDRESS
6310.1	GIVE LIQUOR TO MINOR	GIVE LIQUOR TO MINOR

Table E9. Vehicle Violations – Non-Violation (Category 9)

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
15722	CANCEL ALTERED LIC.	CANCEL ALTERED LIC.
15725	CANCEL FRAUDULENT LICENSE	CANCEL FRAUDULENT LICENSE
15729	CANCEL VOL. SURR.	CANCEL VOL. SURR.
1572	CANCELLATION OF LICENSE	CANCELLATION OF LICENSE
15727	CDLIS CANCELLATION	CDLIS CANCELLATION
CDLW	CDLIS SUSPENSION HISTORY	CDLIS SUSPENSION HISTORY
CORTORDR	COURT ORDERED REVOCATION	COURT ORDERED REVOCATION
CORTORDS	COURT ORDERED SUSPENSION	COURT ORDERED SUSPENSION
618F	COURT ORDERED SUSPENSION	COURT ORDERED SUSPENSION
618C	BAD OL CHECK SUSPENSION	BAD OL CHECK SUSPENSION
6041A	LIC ISSUED BEFORE 18BDAY	LIC ISSUED BEFORE 18BDAY
1503A1	LICENSE NOT TO BE ISSUED	LICENSE NOT TO BE ISSUED
1503A2	LICENSE NOT TO BE ISSUED	LICENSE NOT TO BE ISSUED
1503A3	LICENSE NOT TO BE ISSUED	LICENSE NOT TO BE ISSUED
1503A4	LICENSE NOT TO BE ISSUED	LICENSE NOT TO BE ISSUED
1503A5	LICENSE NOT TO BE ISSUED	LICENSE NOT TO BE ISSUED
1503A6	LICENSE NOT TO BE ISSUED	LICENSE NOT TO BE ISSUED
1503A7	LICENSE NOT TO BE ISSUED	LICENSE NOT TO BE ISSUED
1503A8	LICENSE NOT TO BE ISSUED	LICENSE NOT TO BE ISSUED
A1501C	LIMIT NUMBER LICENSE	LIMIT NUMBER LICENSE
1501C	LIMIT NUMBER LICENSE	LIMIT NUMBER LICENSE
1519CS	MEDICAL NONCOMPLY SUSP	MEDICAL NONCOMPLY SUSP
1519C	MEDICAL SUSPENSIONS	MEDICAL SUSPENSIONS
604A249	NDR LICENSE CANCELLATION	NDR LICENSE CANCELLATION
1405J	RECIPROCAL JUDGMENT SUSP	RECIPROCAL JUDGMENT SUSP
REINSTSD	REINSTATE APPLD SUSP/DISQ	REINSTATE APPLD SUSP/DISQ
616A2	REVOCATION-FELONY CONVICT	REVOCATION-FELONY CONVICT
618A2	SUSP-MISDEMEANOR CONVICT	SUSP-MISDEMEANOR CONVICT
A1571	VIOL CONCERN LIC	VIOLATION CONCERN LIC
D27	VIOL LIMITED LIC CND	VIOLATION LIMITED LIC CND
W09	FAIL SURR HAZMAT	FAILURE SURAILROAD HAZMAT
13A14	IMPROPR ADM/DISP-PRESCRIP	IMPROPR ADM/DISP-PRESCRIP
13A14A	IMPROPR ADM/DISP-PRESCRIP	IMPROPR ADM/DISP-PRESCRIP
13A14M	IMPROPR ADM/DISP-PRESCRIP	IMPROPR ADM/DISP-PRESCRIP
W20	UNABLE PASS DL TEST	UNABLE PASS DRIVERS LICENSE TEST
15726	BAD CHECK CANCEL	BAD CHECK CANCEL
15728	CANC PROD RECALL-APDEX	CANC PROD RECALL-APDEX
15721	CANCEL DOUBLE NUMBER	CANCEL DOUBLE NUMBER
1572A1II	CANCEL FRAUDULENT CDL APP	CANCEL FRAUDULENT CDRIVERS LICENSE APP
15724	CANCEL VOL. SURR.	CANCEL VOL. SURR.
4106	CREDIT CARD FRAUD	CREDIT CARD FRAUD
DLCC	DLC CERTIFIED	DLC CERTIFIED
1572A1IV	FAIL TO PAY FEE	FAILURE TO PAY FEE

Vehicle Violation	Vehicle Violation Decode	Vehicle Violation Expanded
1507	FAMILY RPT RECOMMEND	FAMILY RPT RECOMMEND
604A7	LICENSE TO PHYSCLY IMPAIR	LICENSE TO PHYSCLY IMPAIR
HIST	MCSIA DRIVER HISTORY	MCSIA DRIVER HISTORY
1519CR	MEDICAL RECALL	MEDICAL RECALL
1505F	MISREP ID/FACT	MISREP ID/FACT
15723	NDR CANCELLATION	NDR CANCELLATION
1519	PHYS/MENTAL DISABILITY	PHYS/MENTAL DISABILITY
W15	PHYSN RPT RECOMMENDED	PHYSN RPT RECOMMENDED
REINSTDQ	REINSTATE APPEALED DQ	REINSTATE APPEALED DQ
REINSTAT	REINSTATED APPEAL	REINSTATED APPEAL
DHW	WITHDRAWAL HISTORY	WITHDRAWAL HISTORY
1507D	WITHDRAWAL OF CONSENT	WITHDRAWAL OF CONSENT
W70	WITHDRWL IMMINENT HAZARD	WITHDRWL IMMINENT HAZARD
W00	WITHDRWL NON ACD VIOL	WITHDRWL NON ACD VIOL

Appendix F:
Typical Motorcycle
Driver Profiles

Profiles 1 and 2: Characteristics of a Typical Male Motorcycle Driver Involved in a Non-fatal vs. Fatal Crash

1. Male, Non-fatal Crash	2. Male, Fatal Crash
Driver Characteristics	
▪ 35 years old at the time of the crash ▪ 5’ 10” tall ▪ Possessed a Pennsylvania class CM license ▪ Crashed about 2.25 years after initial MBAC date ▪ Sustained minor to moderate injuries in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 prior driving violation, which was most likely to be speeding	▪ 35 years old at the time of the crash ▪ 5’ 10” tall ▪ Possessed a Pennsylvania class CM license ▪ Crashed about 3 years after initial MBAC date ▪ Killed in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 prior driving violation, which was most likely to be speeding
Motorcycle Characteristics	
▪ Drove a 1997 model year cruiser with a 900cc engine	▪ Drove a 1998 model year cruiser with a 900cc engine
Crash Characteristics	
▪ The crash occurred in an urban area ▪ The crash occurred at 4:00pm ▪ The crash was slightly more likely to involve 2 vehicles than 1 ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit another vehicle at an angle, or crashed without a collision, while speeding/driving too fast for conditions or engaging in other improper driving actions	▪ The crash was slightly more likely to have occurred in an urban than a rural area ▪ The crash occurred at 4:49 pm ▪ 2 vehicles were involved in the crash ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit a fixed object, or hit another vehicle at an angle, while speeding/driving too fast for conditions, or while affected by physical condition (generally, DUI)
Driver Choices and Actions	
▪ Wore a helmet ▪ Did not have a passenger	▪ Wore a helmet ▪ Did not have a passenger

Note. Profiles 1 and 2 are based on 22,577 and 1,240 male motorcycle drivers, respectively, who crashed on Pennsylvania roads between 1997 and 2007.

Profiles 3 and 4: Characteristics of a Typical Female Motorcycle Driver Involved in a Non-fatal vs. Fatal Crash

3. Female, Non-fatal Crash	4. Female, Fatal Crash
Driver Characteristics	
▪ 40 years old at the time of the crash ▪ 5’ 5” tall ▪ Possessed a Pennsylvania class CM license ▪ Crashed about 1.5 years after initial MBAC date ▪ Sustained minor to moderate injuries in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of no prior driving violations	▪ 41 years old at the time of the crash ▪ 5’ 3” tall ▪ Possessed a Pennsylvania class CM license ▪ Crashed 1.5 years after initial MBAC date ▪ Killed in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of no prior driving violations
Motorcycle Characteristics	
▪ Drove a 1997 model year cruiser with a 700cc engine	▪ Drove a 1999 model year cruiser with a 900cc engine
Crash Characteristics	
▪ The crash was slightly more likely to have occurred in an urban than a rural area ▪ The crash occurred at 3:38pm ▪ 1 vehicle was involved in the crash ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit a fixed object, another vehicle, or crashed without a collision, while over/under-compensating on a curve or engaging in other improper driving actions	▪ The crash occurred in a rural area ▪ The crash occurred at 3:09 pm ▪ 2 vehicles were involved in the crash ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit another vehicle head-on while driving on the wrong side of the road, or over/under-compensating on a curve
Driver Choices and Actions	
▪ Wore a helmet ▪ Did not have a passenger	▪ Wore a helmet ▪ Did not have a passenger

Note. Profiles 3 and 4 are based on 1,254 and 22 female motorcycle drivers, respectively, who crashed on Pennsylvania roads between 1997 and 2007.

Profiles 5 and 6: Characteristics of a Typical Sport Bike Driver Involved in a Non-fatal vs. Fatal Crash

5. Sport Bike, Non-fatal Crash	6. Sport Bike, Fatal Crash
Driver Characteristics	
▪ Male ▪ 25 years old at the time of the crash ▪ 5' 10" tall ▪ Possessed a Pennsylvania class CM license ▪ Crashed 1.25 years after initial MBAC date ▪ Sustained minor to moderate injuries in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 prior driving violation, which was most likely to be speeding	▪ Male ▪ 25 years old at the time of the crash ▪ 5' 10" tall ▪ Possessed a Pennsylvania class C license ▪ Crashed almost 2 years after initial MBAC date ▪ Killed in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 prior driving violation, which was most likely to be speeding
Motorcycle Characteristics	
▪ Drove a 1999 model year sport bike with a 600cc engine	▪ Drove a 1999 model year sport bike with a 600cc engine
Crash Characteristics	
▪ The crash occurred in an urban area ▪ The crash occurred at 4:18 pm ▪ The crash was equally likely to involve 1 or 2 vehicles ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit another vehicle at an angle, or crashed without a collision, while speeding/driving too fast for conditions	▪ The crash occurred in an urban area ▪ The crash occurred at 4:17 pm ▪ 2 vehicles were involved in the crash ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit a fixed object, or hit another vehicle at an angle, while speeding/driving too fast for conditions
Driver Choices and Actions	
▪ Wore a helmet ▪ Did not have a passenger	▪ Wore a helmet ▪ Did not have a passenger

Note. Profiles 5 and 6 are based on 4,365 and 289 sport bike drivers, respectively, who crashed on Pennsylvania roads between 1997 and 2007.

Profiles 7 and 8: Characteristics of a Typical Cruiser Driver Involved in a Non-fatal vs. Fatal Crash

7. Cruiser, Non-fatal Crash	8. Cruiser, Fatal Crash
Driver Characteristics	
▪ Male ▪ 42 years old at the time of the crash ▪ 5’ 10” tall ▪ Possessed a Pennsylvania class CM license ▪ Crashed about 3.33 years after initial MBAC date ▪ Sustained minor to moderate injuries in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 or more prior driving violations, which were most likely to be speeding	▪ Male ▪ 42 years old at the time of the crash ▪ 5’ 10” tall ▪ Possessed a Pennsylvania class CM license ▪ Crashed about 4.33 years after initial MBAC date ▪ Killed in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 or more prior driving violations, which were most likely to be speeding
Motorcycle Characteristics	
▪ Drove a 1995 model year cruiser with a 1100cc engine	▪ Drove a 1996 model year cruiser with a 1200cc engine
Crash Characteristics	
▪ The crash occurred in an urban area ▪ The crash occurred at 3:51pm ▪ The crash was slightly more likely to involve 2 vehicles than 1 ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit another vehicle at an angle, or crashed without a collision, while speeding/driving too fast for conditions or engaging in other improper driving actions	▪ The crash occurred in a rural area ▪ The crash occurred at 4:38 pm ▪ The crash was slightly more likely to involve 2 vehicles than 1 ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit a fixed object, or hit another vehicle at an angle, while speeding/driving too fast for conditions, or while affected by physical condition (generally, DUI)
Driver Choices and Actions	
▪ Wore a helmet ▪ Did not have a passenger	▪ Wore a helmet ▪ Did not have a passenger

Note. Profiles 7 and 8 are based on 11,450 and 604 cruiser drivers, respectively, who crashed on Pennsylvania roads between 1997 and 2007.

Profiles 9 and 10: Characteristics of a Typical Unknown Bike Type Driver Involved in a Non-fatal vs. Fatal Crash

9. Unknown Bike Type, Non-fatal Crash	10. Unknown Bike Type, Fatal Crash
Driver Characteristics	
▪ Male ▪ 31 years old at the time of the crash ▪ 5' 10" tall ▪ Possessed a Pennsylvania class CM license ▪ Crashed about 1.75 years after initial MBAC date ▪ Sustained minor to moderate injuries in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 or more prior driving violations, which were most likely to be speeding	▪ Male ▪ 29 years old at the time of the crash ▪ 5' 10" tall ▪ Possessed a Pennsylvania class C or CM license ▪ Crashed about 2.4 years after initial MBAC date ▪ Killed in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 or more prior driving violations, which were most likely to be speeding
Motorcycle Characteristics	
▪ Drove a 1998 model year motorcycle with a 750cc engine	▪ Drove a 1999 model year motorcycle with a 750cc engine
Crash Characteristics	
▪ The crash occurred in an urban area ▪ The crash occurred at 4:03pm ▪ The crash was slightly more likely to involve 2 vehicles than 1 ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit another vehicle at an angle, or crashed without a collision, while speeding/driving too fast for conditions or engaging in other improper driving actions	▪ The crash occurred in an urban area ▪ The crash occurred at 5:15 pm ▪ 2 vehicles were involved in the crash ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit a fixed object, or hit another vehicle at an angle, while speeding/driving too fast for conditions
Driver Choices and Actions	
▪ Wore a helmet ▪ Did not have a passenger	▪ Wore a helmet ▪ Did not have a passenger

Note. Profiles 9 and 10 are based on 7,263 and 335 unknown bike type drivers, respectively, who crashed on Pennsylvania roads between 1997 and 2007.

Profiles 11 and 12: Characteristics of a Typical Motorcycle Driver without MBAC Involved in a Non-fatal vs. Fatal Crash

11. No MBAC, Non-fatal Crash	12. No MBAC, Fatal Crash
Driver Characteristics	
▪ Male ▪ 27 years old at the time of the crash ▪ Possessed a Pennsylvania class C license ▪ Sustained moderate injuries in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer	▪ Male ▪ 27 years old at the time of the crash ▪ Possessed a Pennsylvania class C license ▪ Killed in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol was suspected by the investigating police officer (and confirmed by testing for most of those suspected)
Motorcycle Characteristics	
▪ Drove a 1995 model year motorcycle with a 650cc engine	▪ Drove a 1995 model year motorcycle with a 650cc engine
Crash Characteristics	
▪ The crash occurred in an urban area ▪ The crash occurred at 4:45pm ▪ The crash was equally likely to involve 1 or 2 vehicles ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit a fixed object, hit another vehicle at an angle, or crashed without a collision, while speeding/driving too fast for conditions or engaging in other improper driving actions	▪ The crash occurred in an urban area ▪ The crash occurred at 5:21 pm ▪ 2 vehicles were involved in the crash ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit a fixed object, or hit another vehicle at an angle, while speeding/driving too fast for conditions, or while affected by physical condition (generally, DUI)
Driver Choices and Actions	
▪ Only slightly more likely to have worn a helmet than not ▪ Did not have a passenger	▪ Wore a helmet ▪ Did not have a passenger

Note. Profiles 11 and 12 are based on 2,448 and 227 motorcycle drivers without MBAC (class M license/permit Business Action Code), respectively, who crashed on Pennsylvania roads between 1997 and 2007.

Profiles 13 and 14: Characteristics of a Typical Motorcycle Driver with BRC Pass Involved in a Non-fatal vs. Fatal Crash

13. BRC Pass, Non-fatal Crash	14. BRC Pass, Fatal Crash
Driver Characteristics	
▪ Male ▪ 32 years old at the time of the crash ▪ Possessed a Pennsylvania class CM license ▪ Crashed about 11 months after initial MBAC date ▪ Sustained minor to moderate injuries in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 prior driving violation, which was most likely to be speeding ▪ Passed BRC at age 31 ▪ Achieved a BRC Skills score of 6 ▪ Achieved a BRC Knowledge score of 96 ▪ Crashed about 5 months after passing BRC	▪ Male ▪ 39 years old at the time of the crash ▪ Possessed a Pennsylvania class CM license ▪ Crashed about 14 months after initial MBAC date ▪ Killed in the crash ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 2 or more prior driving violations, which were most likely to be speeding ▪ Passed BRC at age 38 ▪ Achieved a BRC Skills score of 6 ▪ Achieved a BRC Knowledge score of 96 ▪ Crashed about 9 months after passing BRC
Motorcycle Characteristics	
▪ Drove a 2003 model year motorcycle with a 750cc engine	▪ Drove a 2003 model year motorcycle with a 750cc engine
Crash Characteristics	
▪ The crash occurred in an urban area ▪ The crash occurred at 4:00pm ▪ The crash was equally likely to involve 1 or 2 vehicles ▪ The crash occurred in daylight, mid-block on a dry road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Crashed without a collision, hit another vehicle at an angle, or hit a fixed object while speeding/driving too fast for conditions	▪ The crash occurred in an urban area ▪ The crash occurred at 2:50 pm ▪ 2 vehicles were involved in the crash ▪ The crash occurred in daylight, mid-block on a dry blacktop road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Hit another vehicle at an angle, crashed without a collision, or hit a fixed object while speeding/driving too fast for conditions
Driver Choices and Actions	
▪ Wore a helmet ▪ Did not have a passenger	▪ Only slightly more likely to have worn a helmet than not ▪ Did not have a passenger

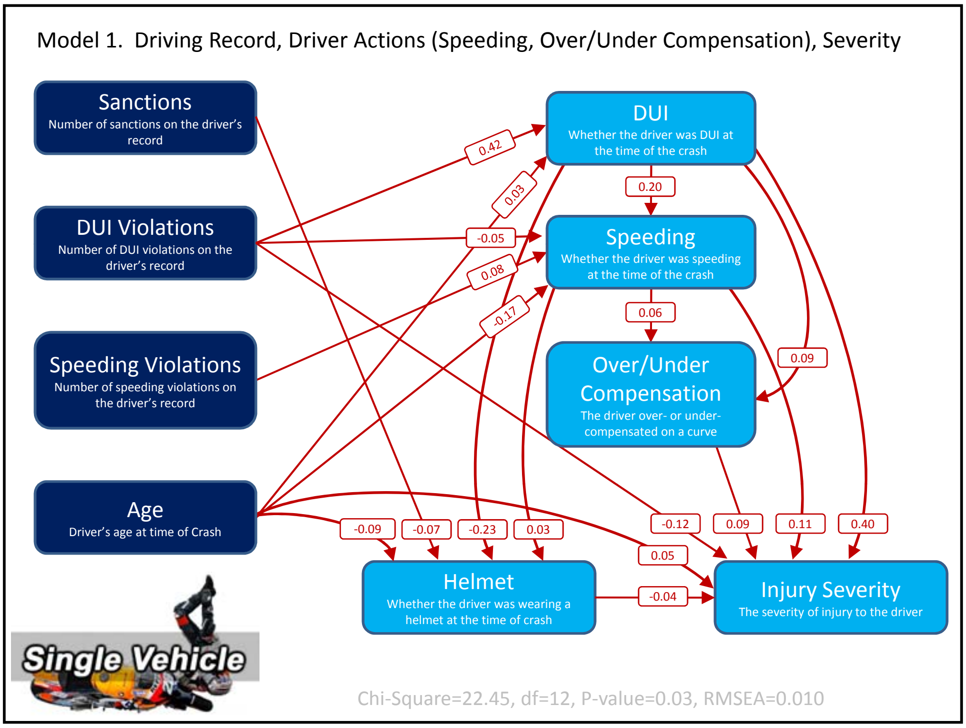
Note. Profiles 13 and 14 are based on 860 and 38 motorcycle drivers who passed a Basic Rider Course (BRC), respectively, and who crashed on Pennsylvania roads between 1997 and 2007.

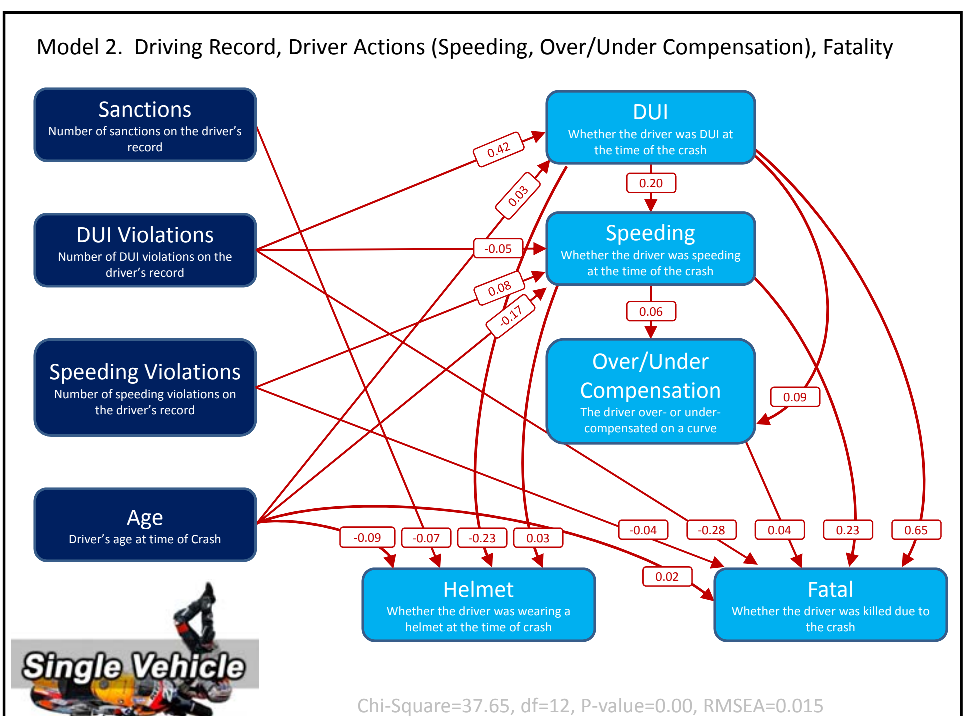
Profiles 15 and 16: Characteristics of a Typical Motorcycle Driver with ERC Pass Involved in a Non-fatal vs. Fatal Crash

15. ERC Pass, Non-fatal Crash	16. ERC Pass, Fatal Crash
Driver Characteristics	
▪ Male ▪ 32 years old at the time of the crash ▪ Possessed a Pennsylvania class CM license ▪ Sustained minor injuries in the crash ▪ Crashed about 15 months after initial MBAC date ▪ At fault for the crash, according to the investigating police officer ▪ Alcohol and/or illegal drugs were not suspected by the investigating police officer ▪ Convicted of 1 or more prior driving violations, which were most likely to be speeding ▪ Passed ERC at age 32 ▪ Crashed about 1 month after passing ERC	*Insufficient Cases*
Motorcycle Characteristics	
▪ Drove a 2004 model year motorcycle with a 750cc engine	*Insufficient Cases*
Crash Characteristics	
▪ The crash occurred in an urban area ▪ The crash occurred at 3:14 pm ▪ The crash was equally likely to involve 1 or 2 vehicles ▪ The crash occurred in daylight, mid-block on a dry road ▪ No adverse environmental factors (weather, glare, obstacle in roadway, etc.) were implicated in the crash ▪ Crashed without a collision, hit a fixed object, or rear-ended another vehicle while speeding/driving too fast for conditions	*Insufficient Cases*
Driver Choices and Actions	
▪ Wore a helmet ▪ Did not have a passenger	*Insufficient Cases*

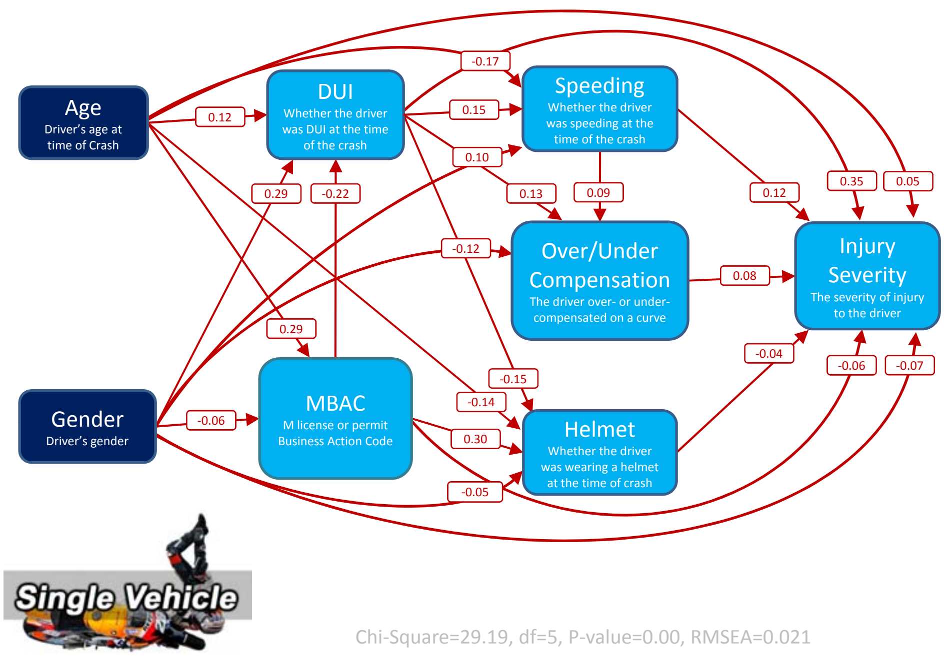
Note. Profiles 15 and 16 are based on 39 and 2 motorcycle drivers who passed an Experienced Rider Course (ERC), respectively, and who crashed on Pennsylvania roads between 1997 and 2007.

Appendix G:
Path Diagrams / Models

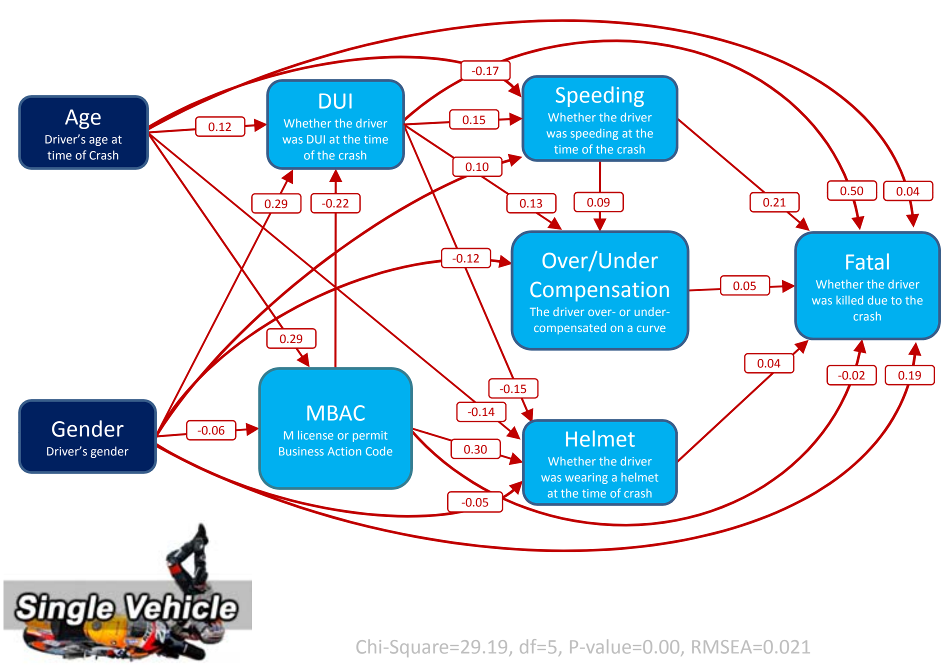

Model 1. Driving Record, Driver Actions (Speeding, Over/Under Compensation), Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Speeding Violations
Number of speeding violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Speeding
Whether the driver was speeding at the time of the crash
Over/Under Compensation
The driver over- or under-compensated on a curve
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.42
0.03
-0.05
0.08
-0.17
0.20
0.06
0.09
-0.09
-0.07
-0.23
0.03
-0.12
0.09
0.11
0.40
0.05
-0.04
Single Vehicle
Chi-Square=22.45, df=12, P-value=0.03, RMSEA=0.010

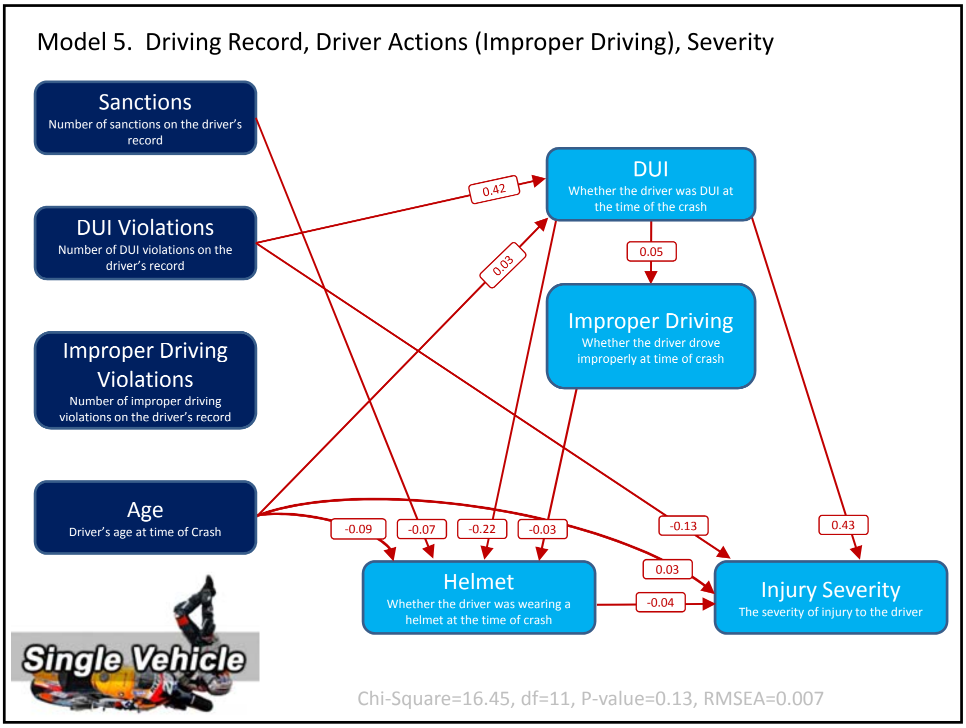

Model 2. Driving Record, Driver Actions (Speeding, Over/Under Compensation), Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Speeding Violations
Number of speeding violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Speeding
Whether the driver was speeding at the time of the crash
Over/Under Compensation
The driver over- or under-compensated on a curve
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.42
0.03
-0.05
0.08
-0.17
0.20
0.06
0.09
-0.09
-0.07
-0.23
0.03
-0.04
-0.28
0.04
0.23
0.65
0.02
Single Vehicle
Chi-Square=37.65, df=12, P-value=0.00, RMSEA=0.015

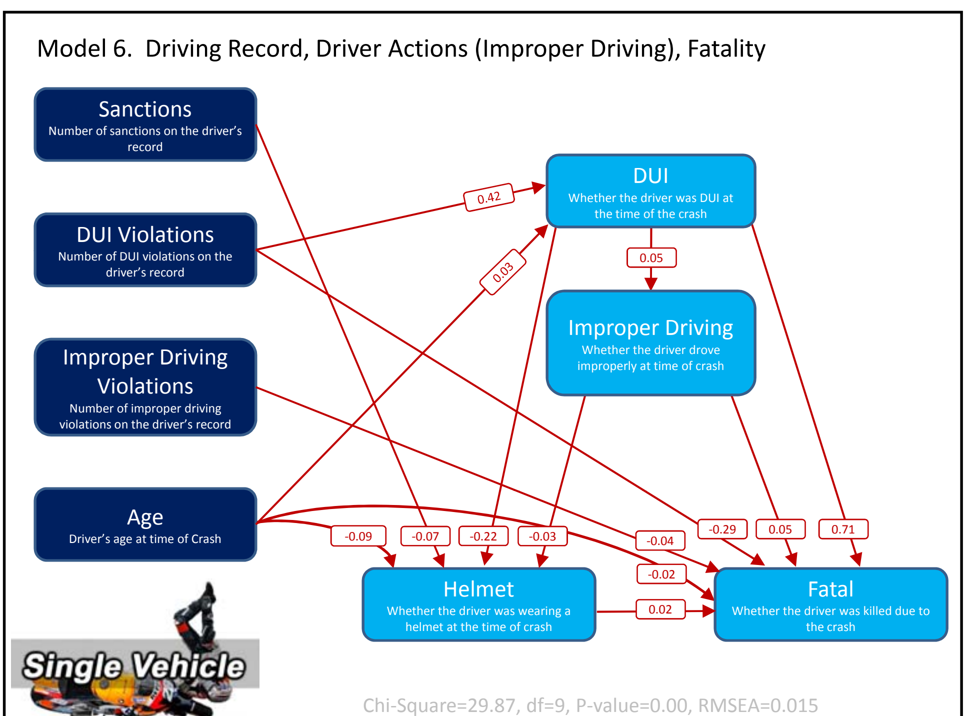
Model 3. Demographics, Driver Actions (Speeding, Over/Under Compensation), Severity

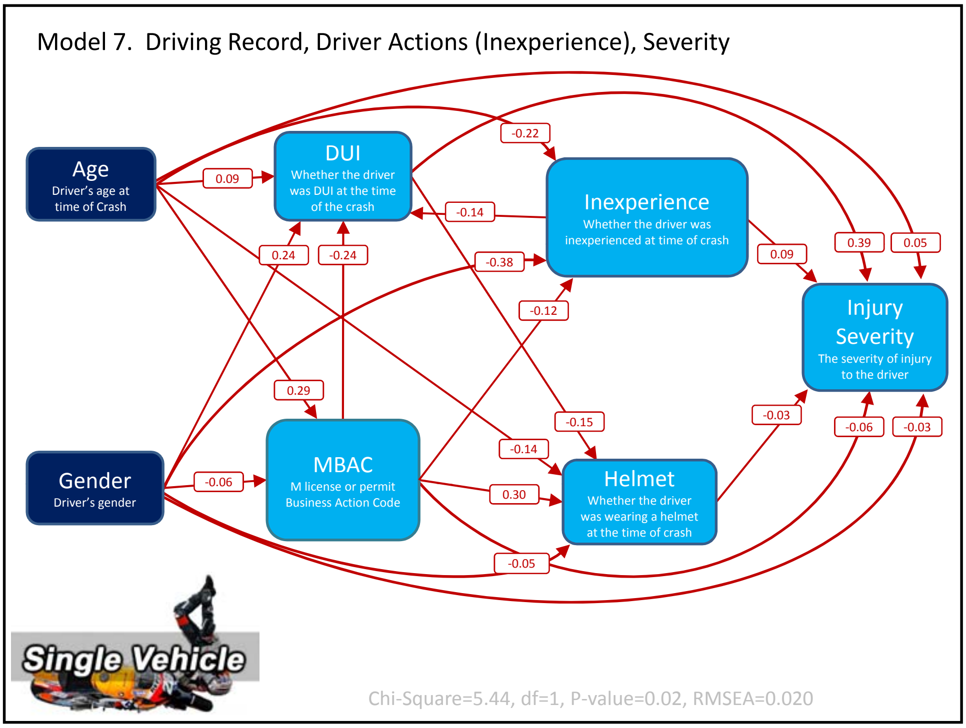


Model 4. Demographics, Driver Actions (Speeding, Over/Under Compensation), Fatality

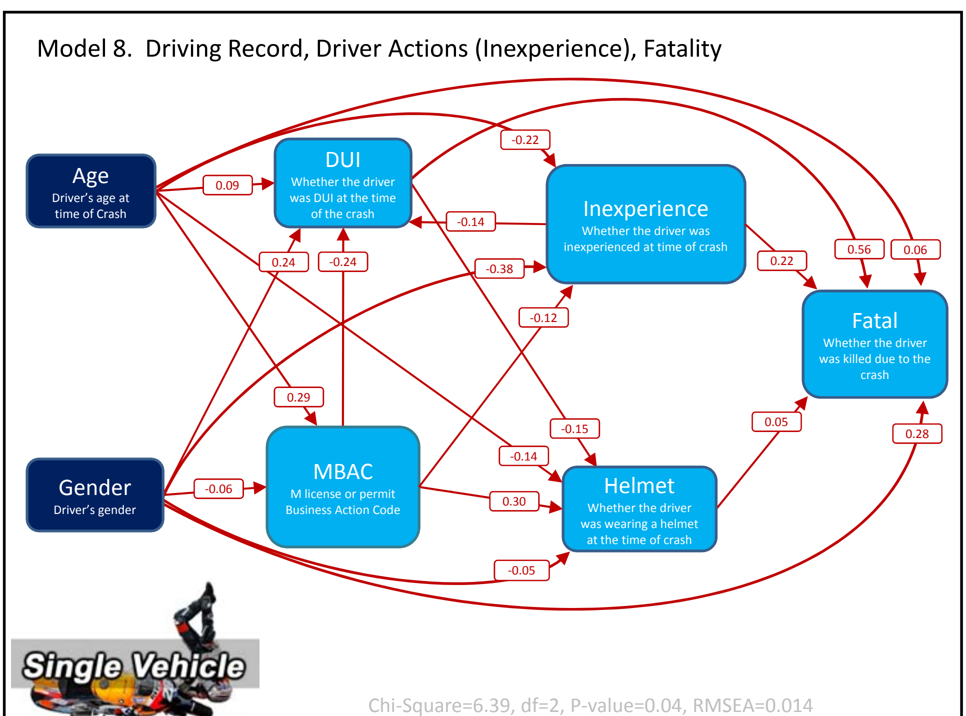



Model 5. Driving Record, Driver Actions (Improper Driving), Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.42
0.03
0.05
-0.09
-0.07
-0.22
-0.03
-0.13
0.43
0.03
-0.04
Single Vehicle
Chi-Square=16.45, df=11, P-value=0.13, RMSEA=0.007

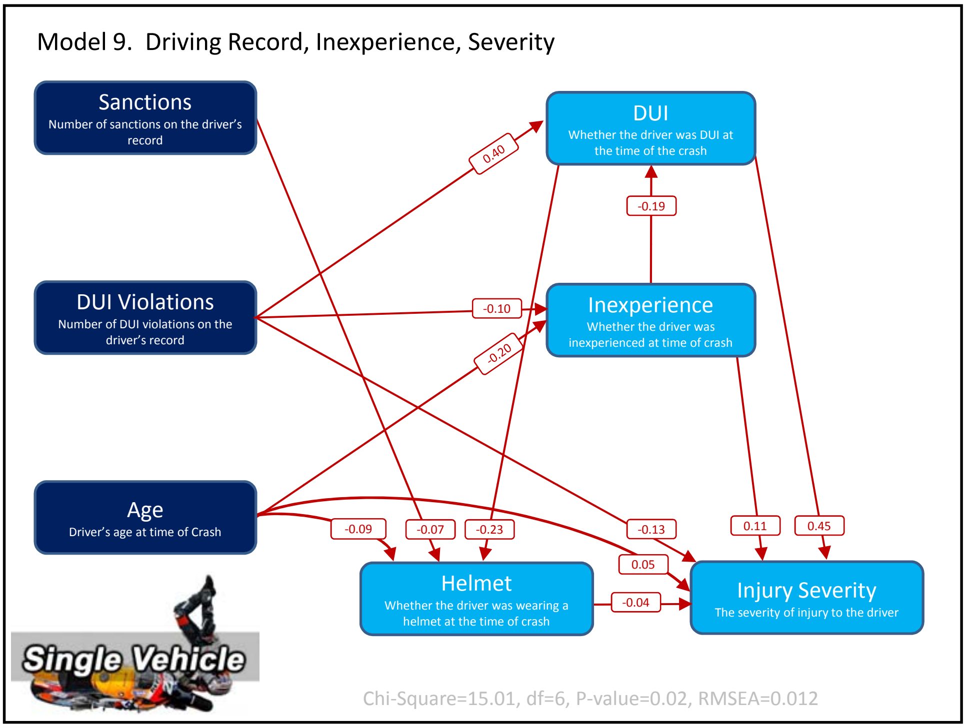

Model 6. Driving Record, Driver Actions (Improper Driving), Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.42
0.03
0.05
-0.09
-0.07
-0.22
-0.03
-0.04
-0.29
0.05
0.71
-0.02
0.02
Single Vehicle
Chi-Square=29.87, df=9, P-value=0.00, RMSEA=0.015

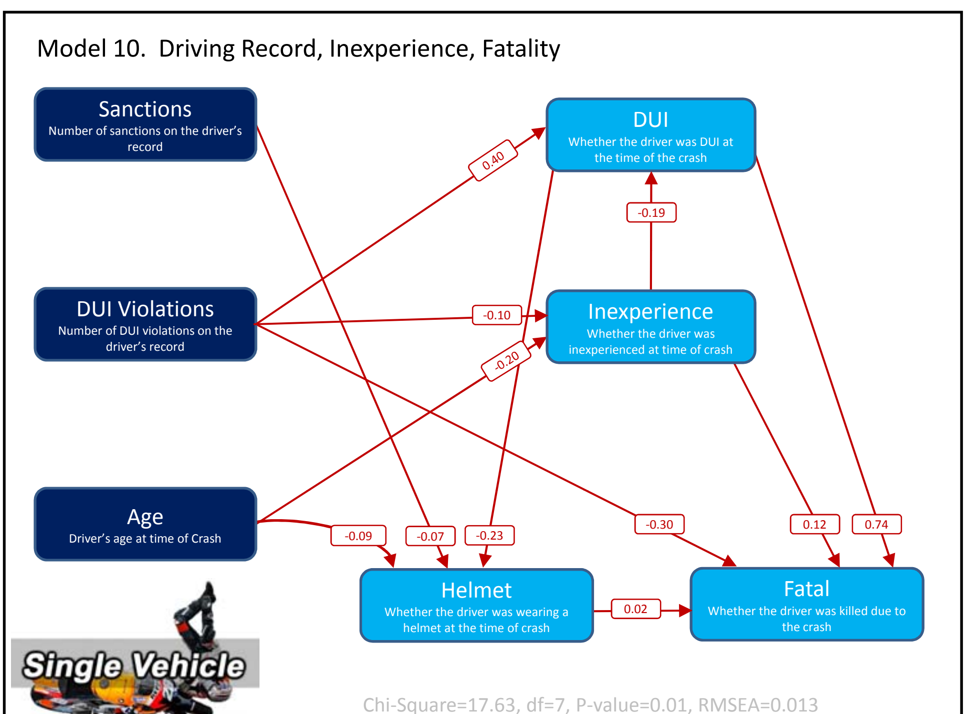


Model 7. Driving Record, Driver Actions (Inexperience), Severity
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Injury Severity
The severity of injury to the driver
Gender
Driver's gender
MBAC
M license or permit Business Action Code
Helmet
Whether the driver was wearing a helmet at the time of crash
0.09
-0.22
-0.14
-0.38
0.24
-0.24
-0.12
0.09
0.39
0.05
0.29
-0.15
-0.14
-0.03
-0.06
-0.03
-0.06
0.30
-0.05
Single Vehicle
Chi-Square=5.44, df=1, P-value=0.02, RMSEA=0.020

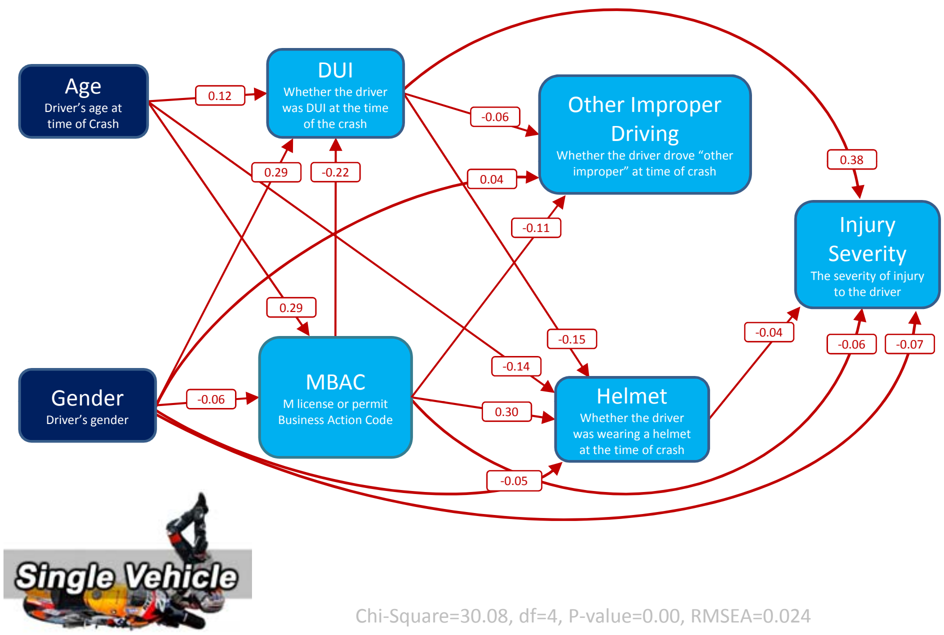


Model 8. Driving Record, Driver Actions (Inexperience), Fatality
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Fatal
Whether the driver was killed due to the crash
Gender
Driver's gender
MBAC
M license or permit Business Action Code
Helmet
Whether the driver was wearing a helmet at the time of crash
0.09
-0.22
-0.14
-0.38
0.24
-0.24
-0.12
0.22
0.56
0.06
0.29
-0.15
-0.14
0.05
0.28
-0.06
0.30
-0.05
Single Vehicle
Chi-Square=6.39, df=2, P-value=0.04, RMSEA=0.014

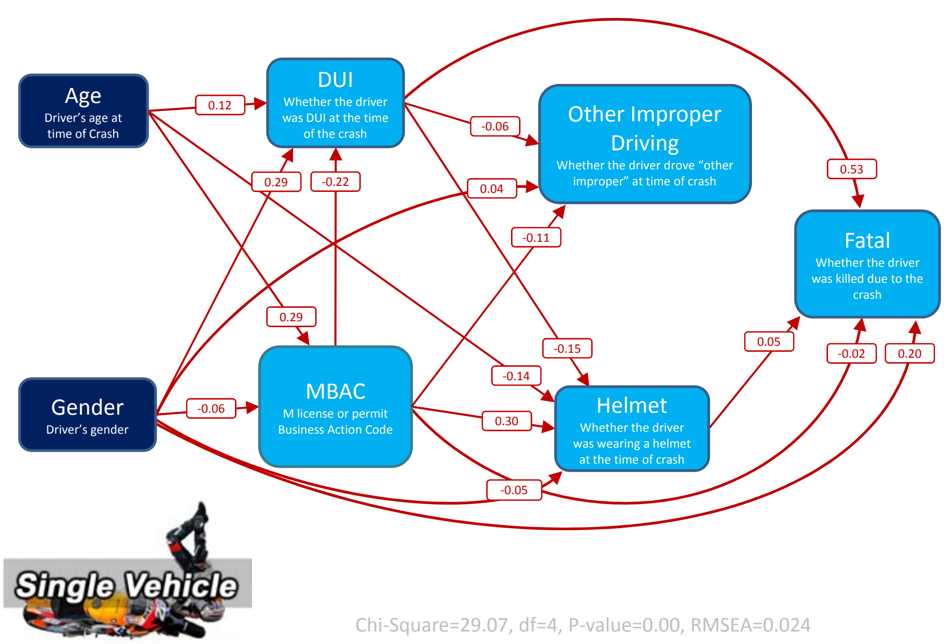

Model 9. Driving Record, Inexperience, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.40
-0.19
-0.10
-0.20
-0.09
-0.07
-0.23
-0.13
0.11
0.45
0.05
-0.04
Single Vehicle
Chi-Square=15.01, df=6, P-value=0.02, RMSEA=0.012


Model 10. Driving Record, Inexperience, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.40
-0.19
-0.10
-0.20
-0.09
-0.07
-0.23
-0.30
0.12
0.74
0.02
Single Vehicle
Chi-Square=17.63, df=7, P-value=0.01, RMSEA=0.013

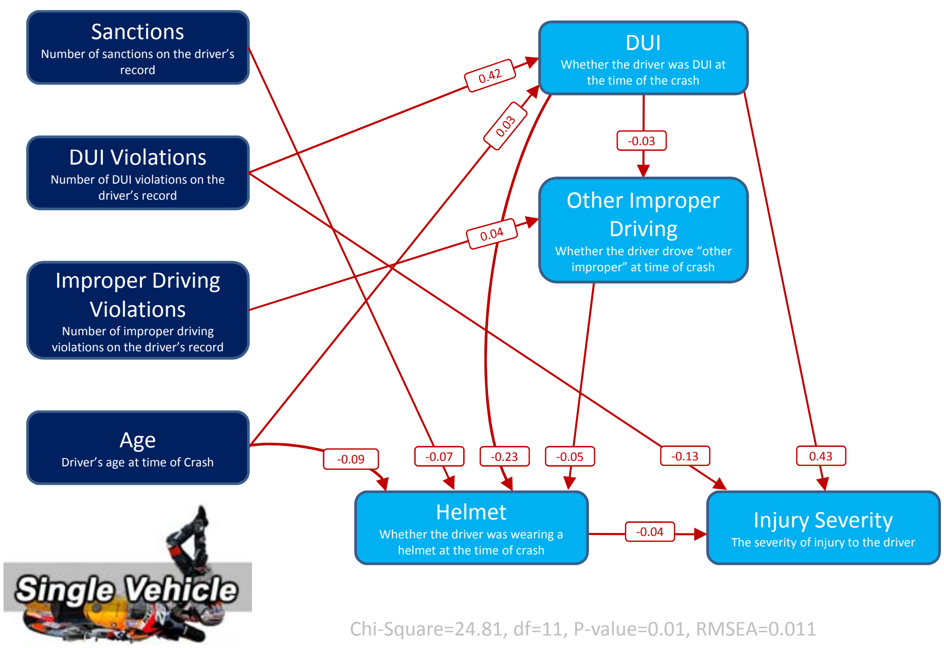
Model 11. Driving Record, Driver Actions (Other Improper), Severity



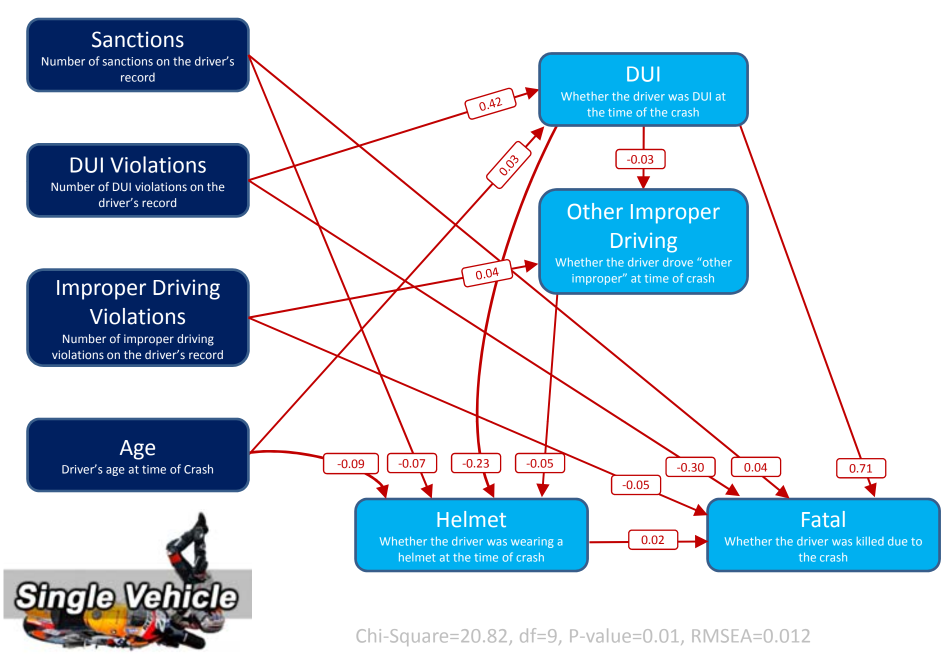
Model 12. Driving Record, Driver Actions (Other Improper), Fatality



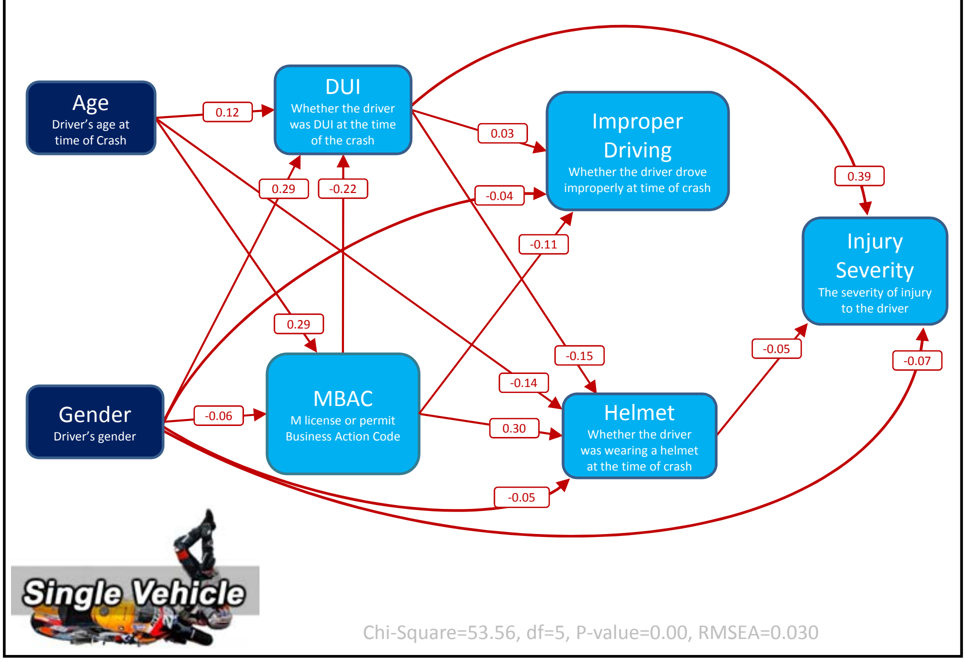
Model 13. Driving Record, Other Improper, Severity



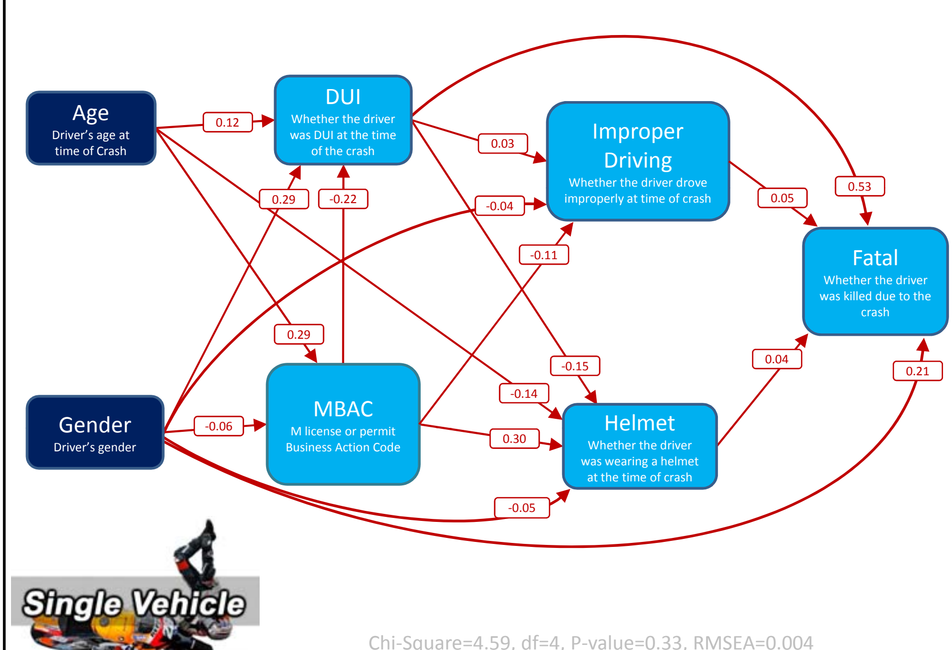
Model 14. Driving Record, Other Improper, Fatality



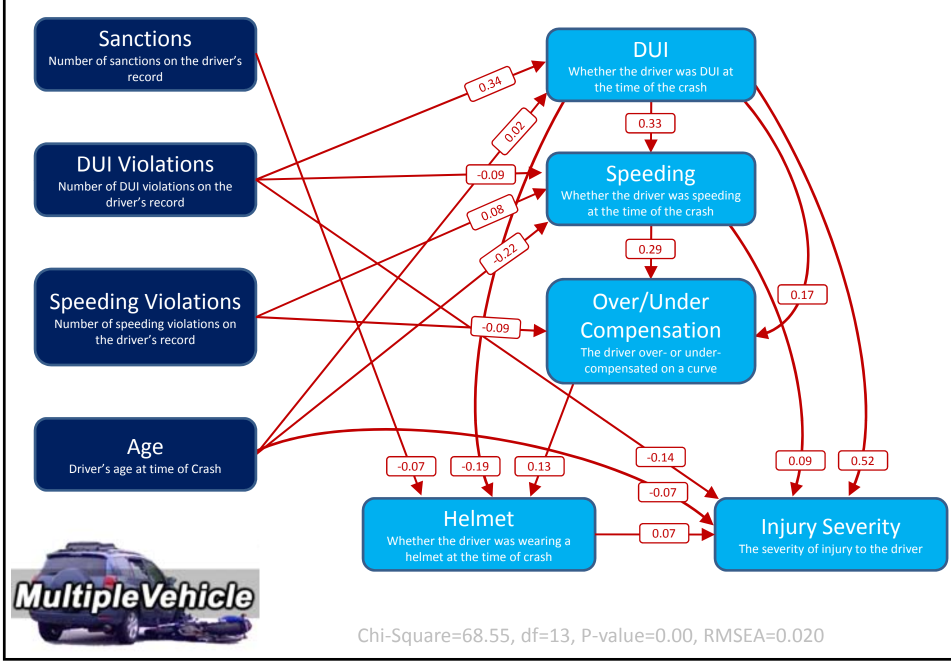
Model 15. Demographics, Driver Actions (Improper Driving), Severity



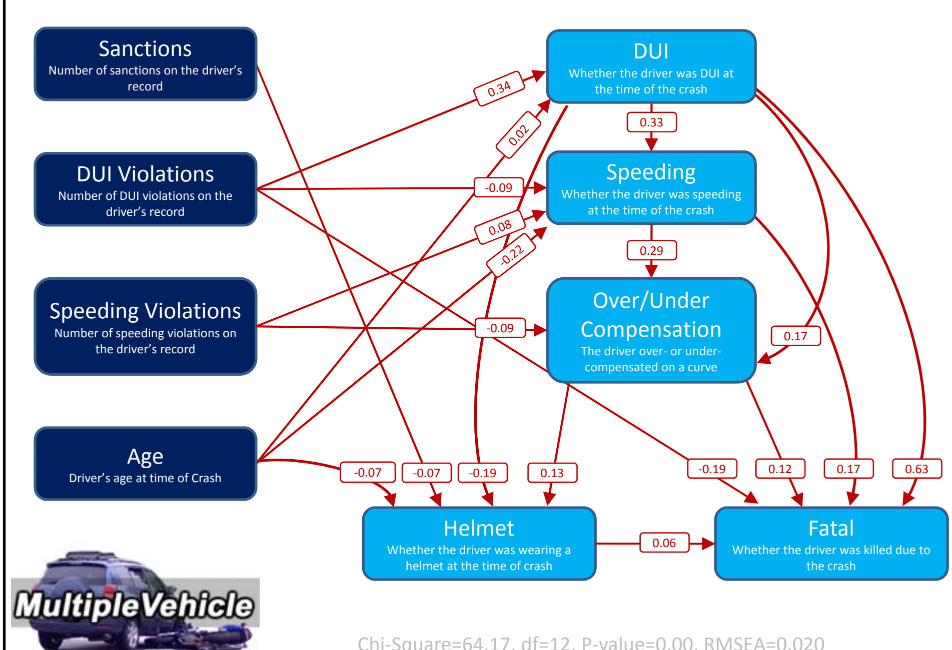
Model 16. Demographics, Driver Actions (Improper Driving), Fatality



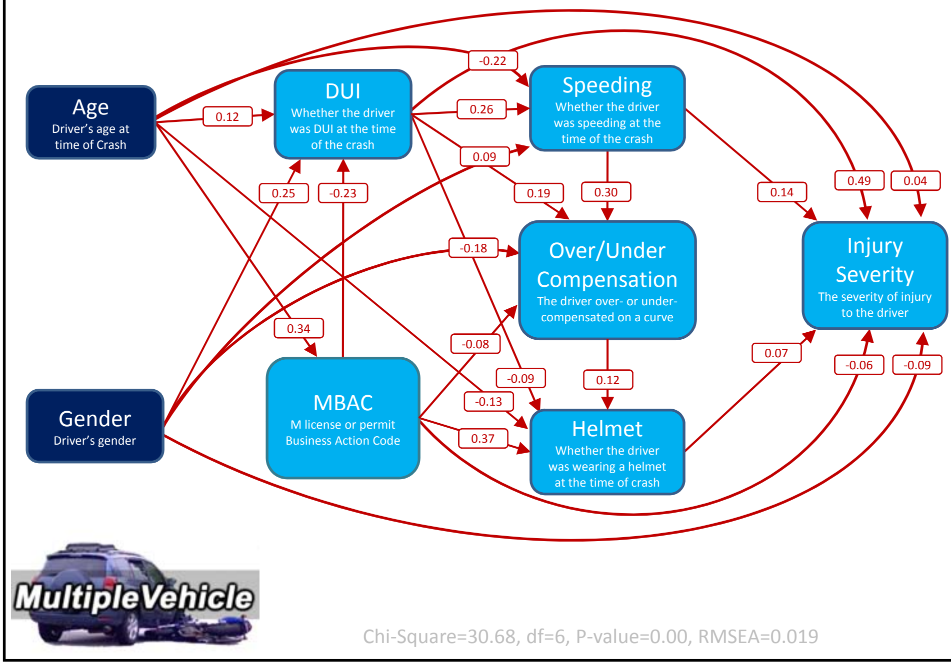
Model 17. Driving Record, Driver Actions (Speeding, Over/Under Compensation), Severity



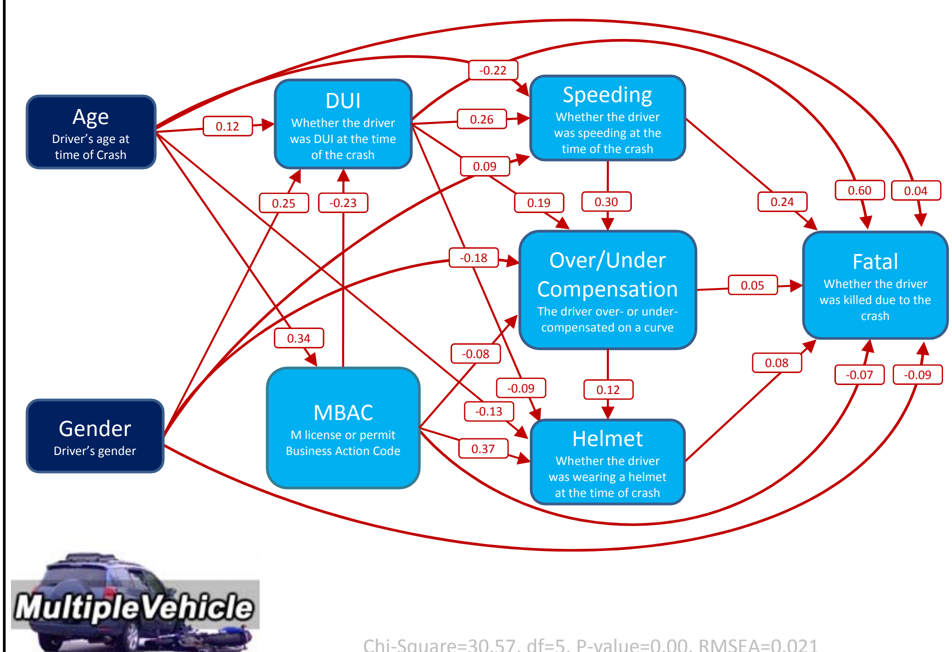
Model 18. Driving Record, Driver Actions (Speeding, Over/Under Compensation), Fatality

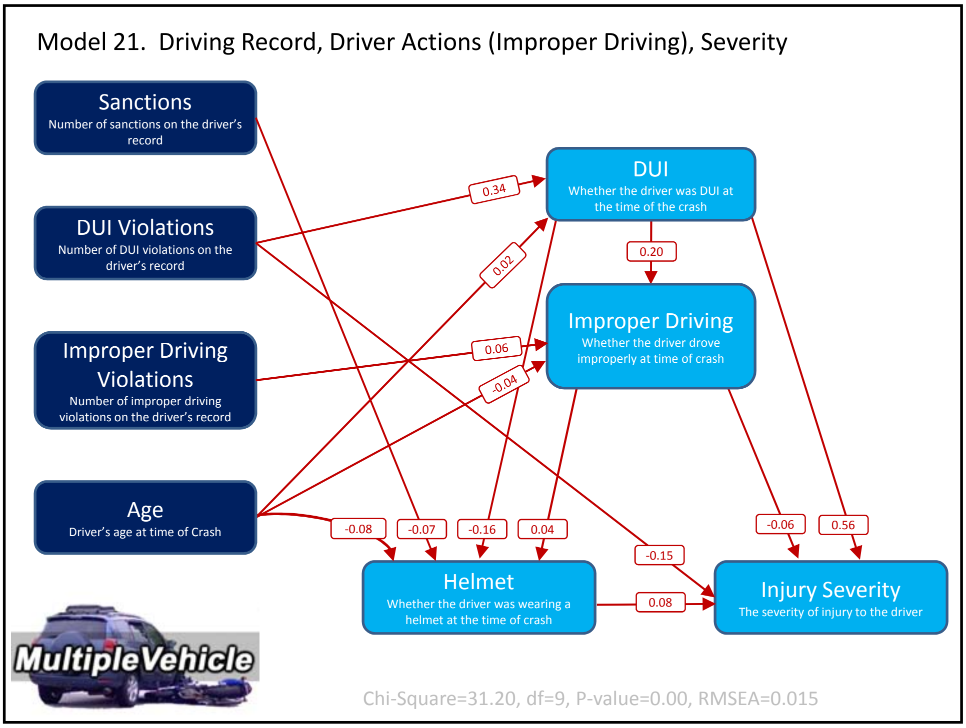


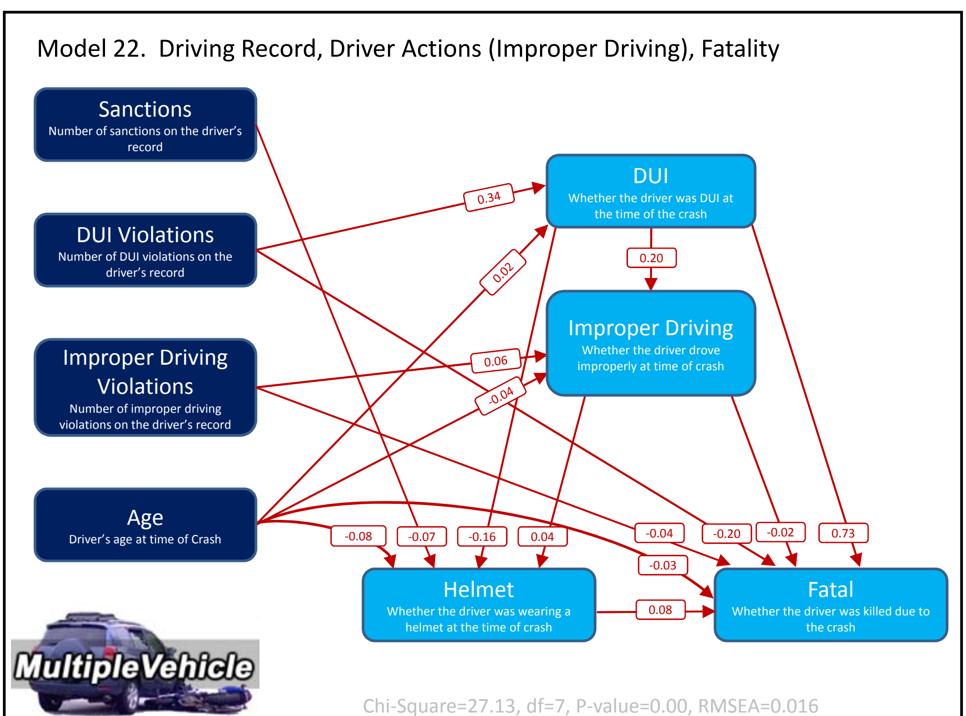
Model 19. Demographics, Driver Actions (Speeding, Over/Under Compensation), Severity



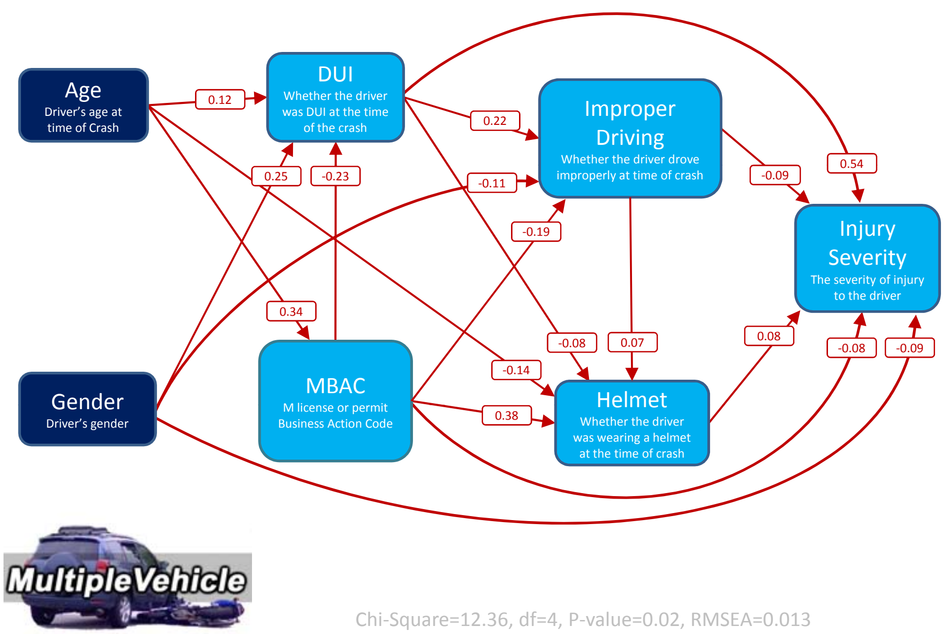
Model 20. Demographics, Driver Actions (Speeding, Over/Under Compensation), Fatality



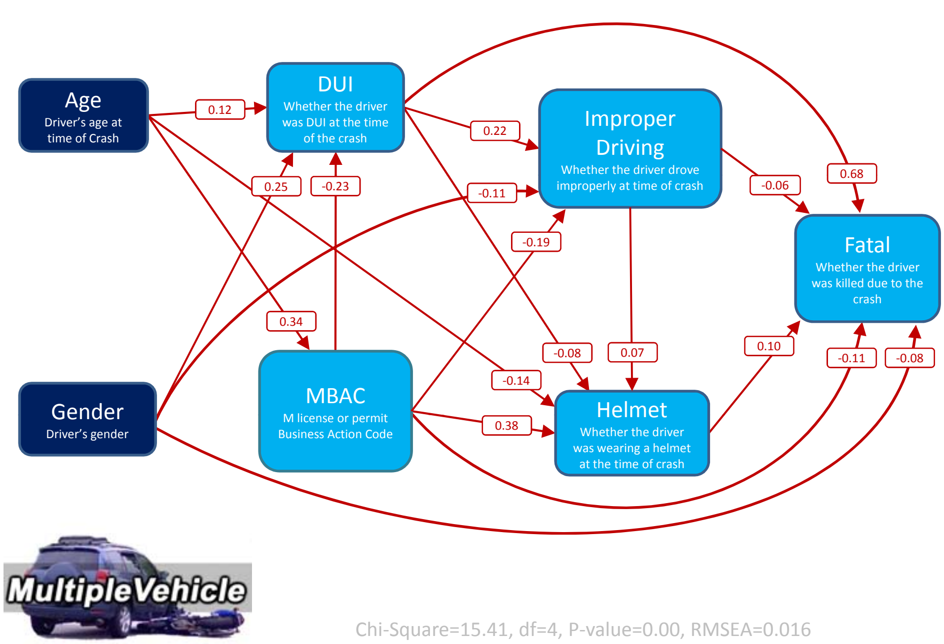

Model 21. Driving Record, Driver Actions (Improper Driving), Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.34
0.02
0.20
0.06
-0.04
-0.08
-0.07
-0.16
0.04
-0.15
-0.06
0.56
0.08
MultipleVehicle
Chi-Square=31.20, df=9, P-value=0.00, RMSEA=0.015

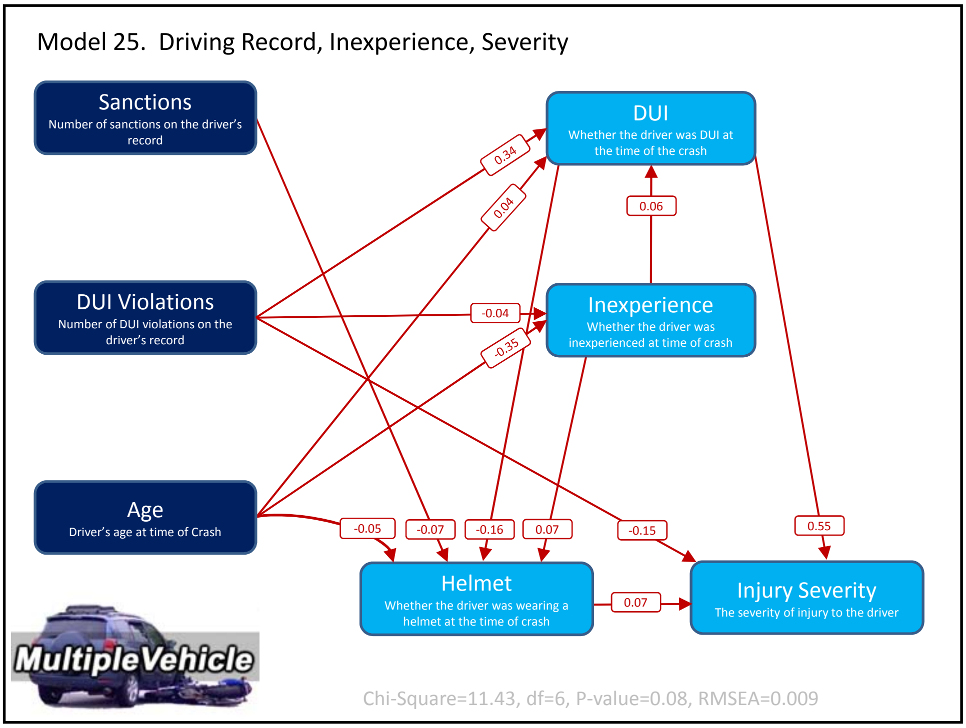

Model 22. Driving Record, Driver Actions (Improper Driving), Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.34
0.02
0.20
0.06
-0.04
-0.08
-0.07
-0.16
0.04
-0.04
-0.20
-0.02
0.73
-0.03
0.08
MultipleVehicle
Chi-Square=27.13, df=7, P-value=0.00, RMSEA=0.016

Model 23. Demographics, Driver Actions (Improper Driving), Severity

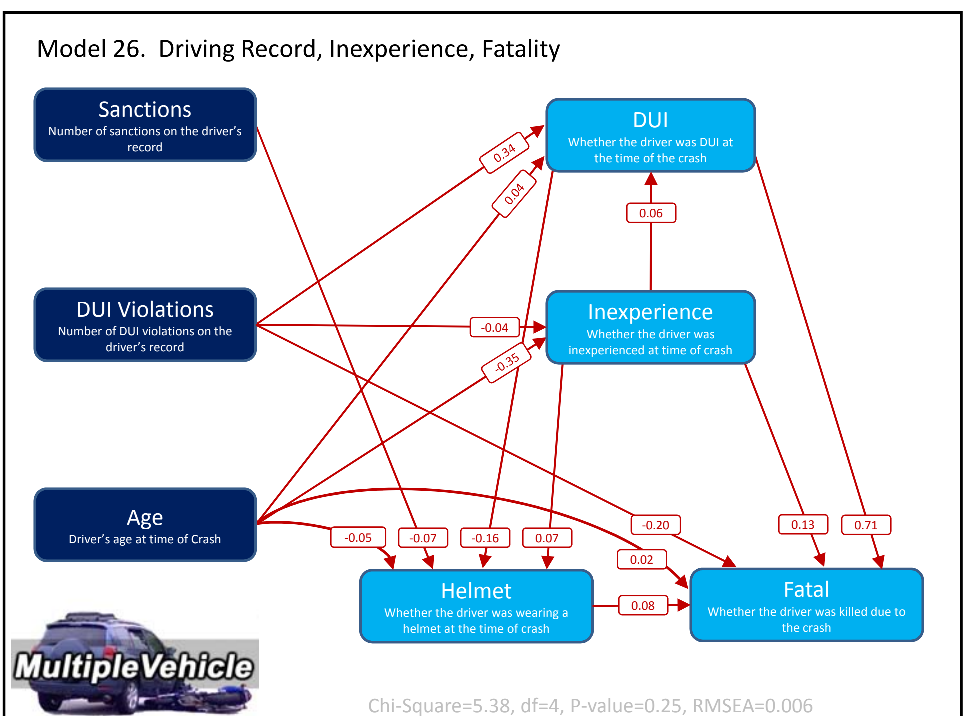


Model 24. Demographics, Driver Actions (Improper Driving), Fatality



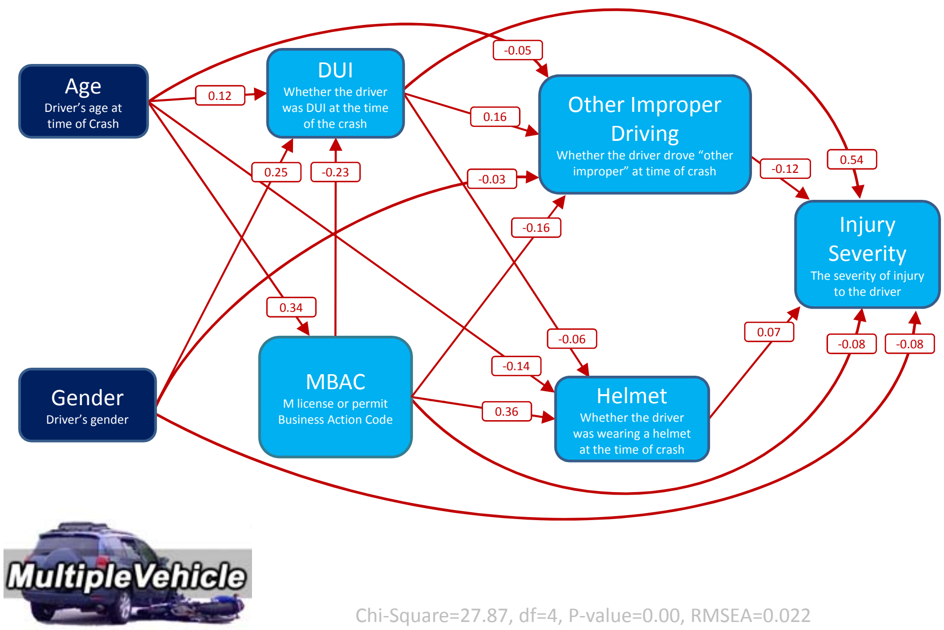


Model 25. Driving Record, Inexperience, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.34
0.04
0.06
-0.04
-0.35
-0.05
-0.07
-0.16
0.07
-0.15
0.55
0.07
MultipleVehicle
Chi-Square=11.43, df=6, P-value=0.08, RMSEA=0.009

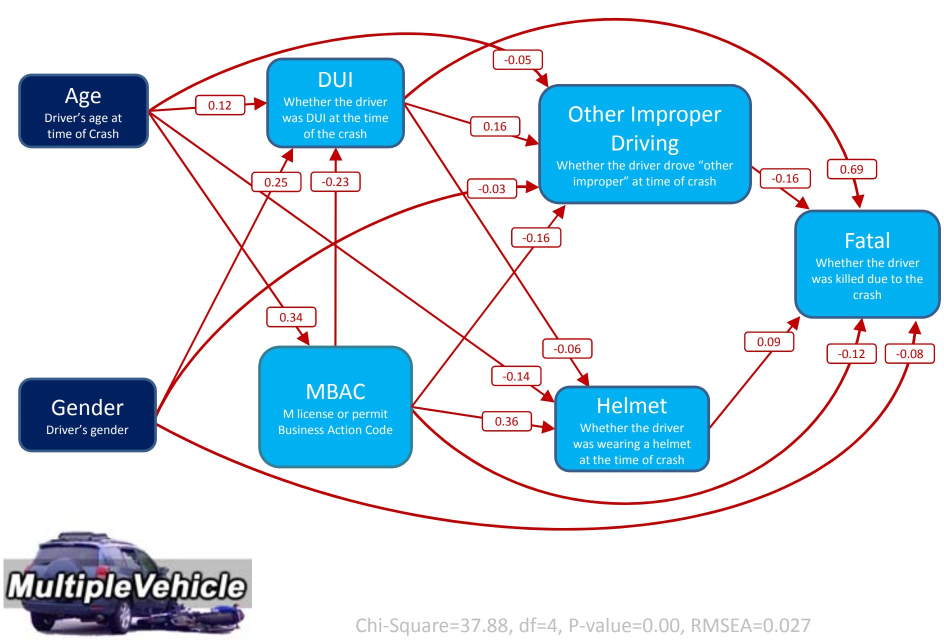


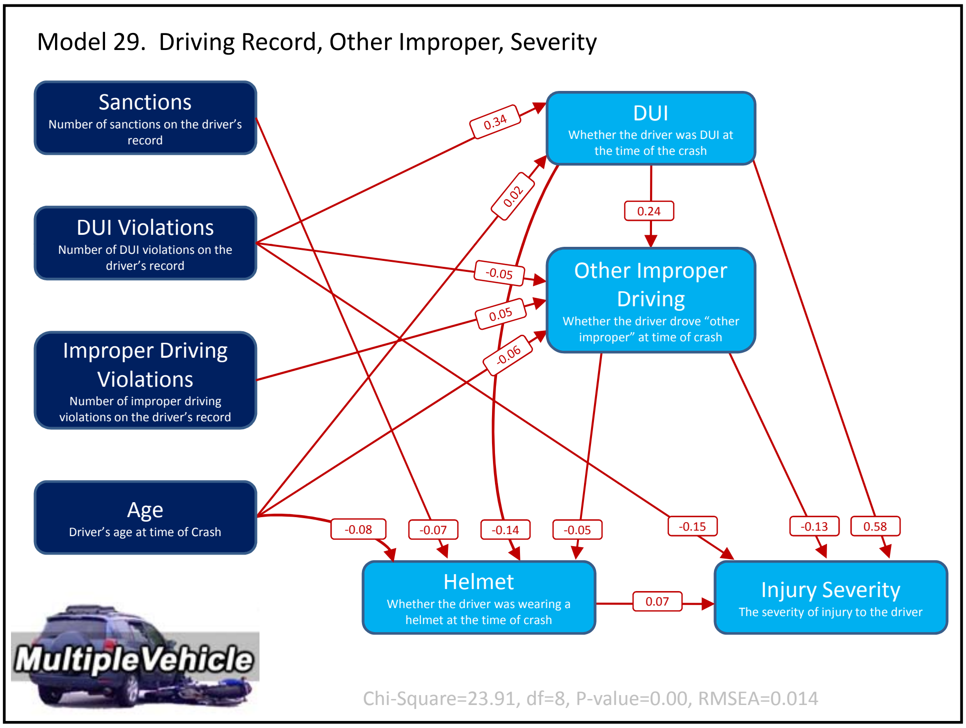
Model 26. Driving Record, Inexperience, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.34
0.04
0.06
-0.04
-0.35
-0.05
-0.07
-0.16
0.07
-0.20
0.02
0.13
0.71
0.08
MultipleVehicle
Chi-Square=5.38, df=4, P-value=0.25, RMSEA=0.006

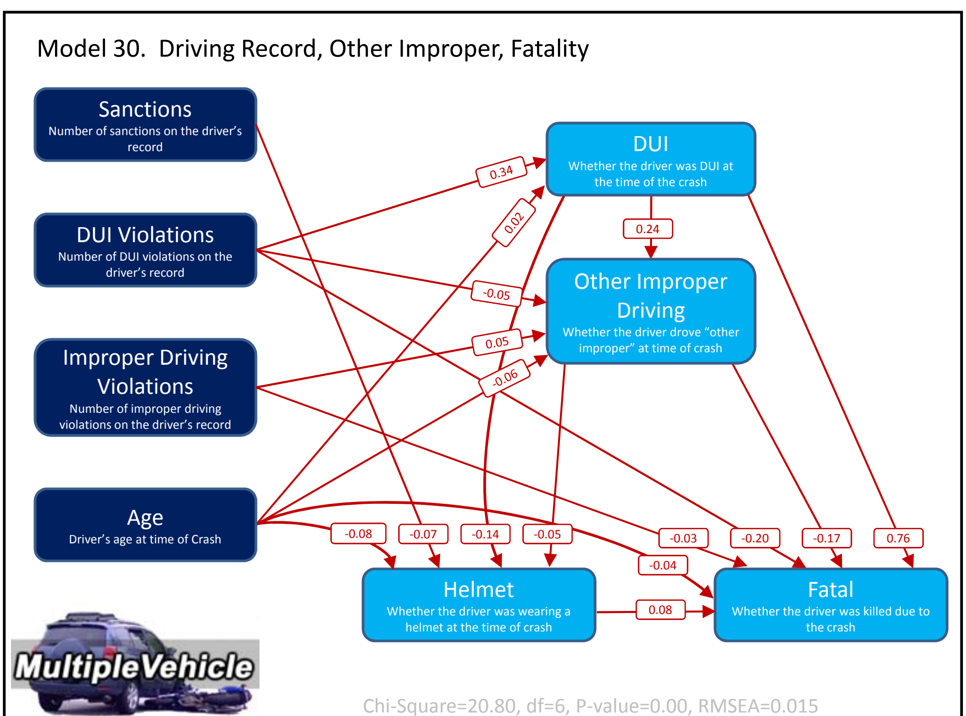
Model 27. Driving Record, Driver Actions (Other Improper), Severity



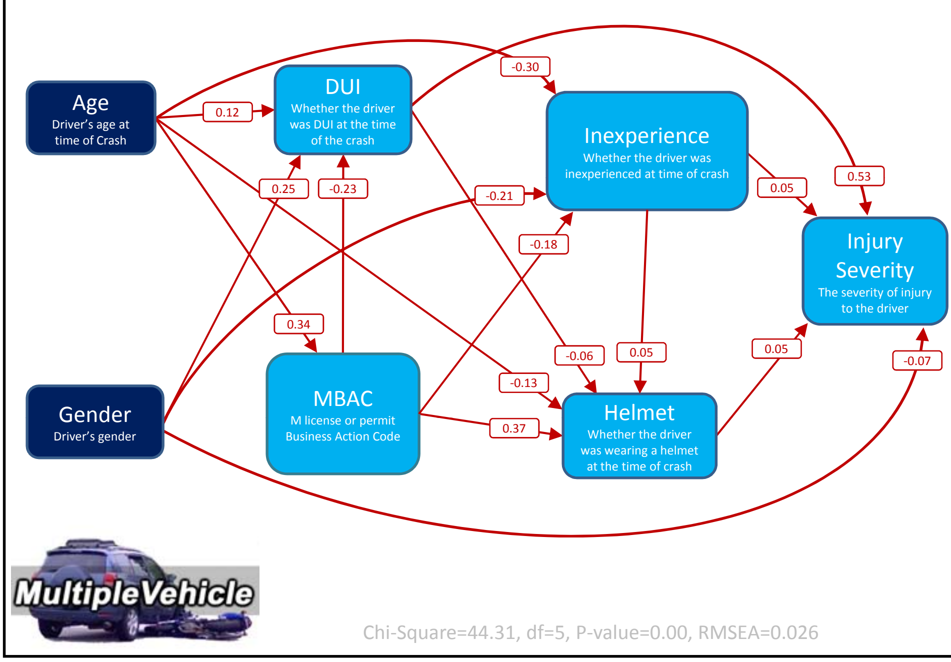
Model 28. Driving Record, Driver Actions (Other Improper), Fatality



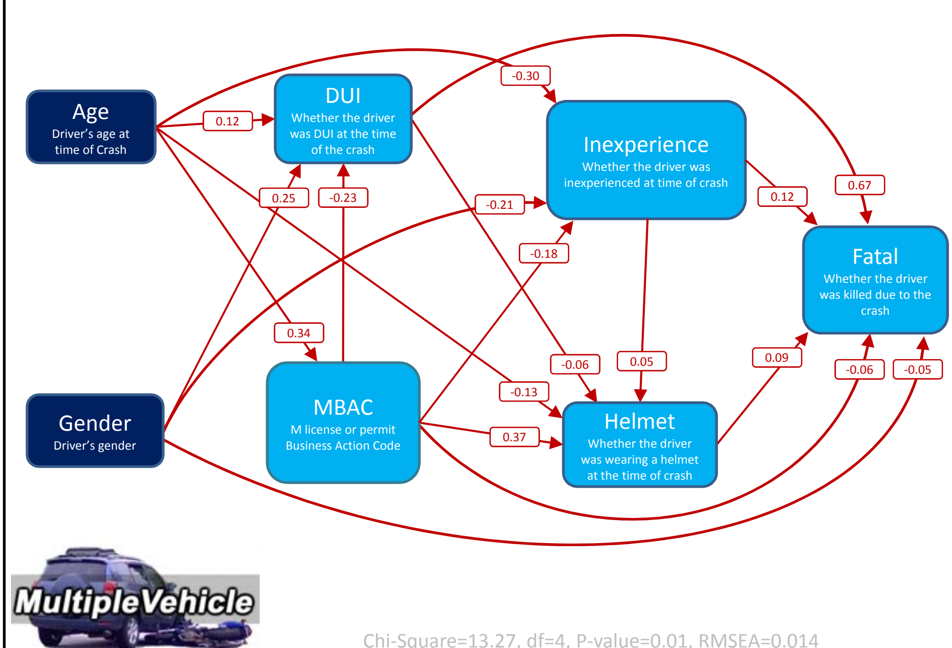

Model 29. Driving Record, Other Improper, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Other Improper Driving
Whether the driver drove "other improper" at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.34
0.02
0.24
-0.05
0.05
-0.06
-0.08
-0.07
-0.14
-0.05
-0.15
-0.13
0.58
0.07
MultipleVehicle
Chi-Square=23.91, df=8, P-value=0.00, RMSEA=0.014


Model 30. Driving Record, Other Improper, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Other Improper Driving
Whether the driver drove "other improper" at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.34
0.02
0.24
-0.05
0.05
-0.06
-0.08
-0.07
-0.14
-0.05
-0.03
-0.20
-0.17
0.76
-0.04
0.08
MultipleVehicle
Chi-Square=20.80, df=6, P-value=0.00, RMSEA=0.015

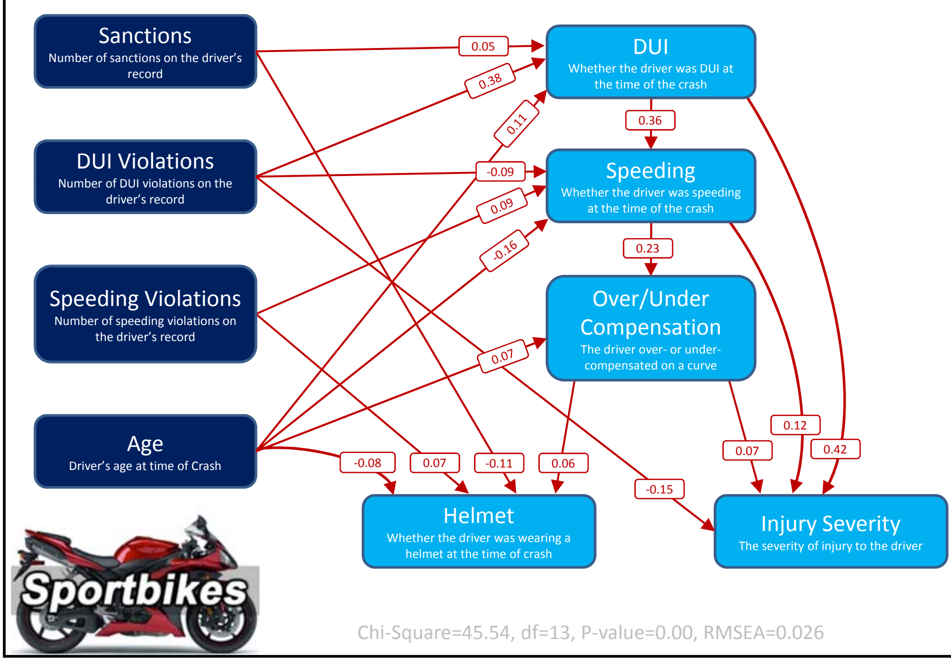
Model 31. Driving Record, Driver Actions (Inexperience), Severity



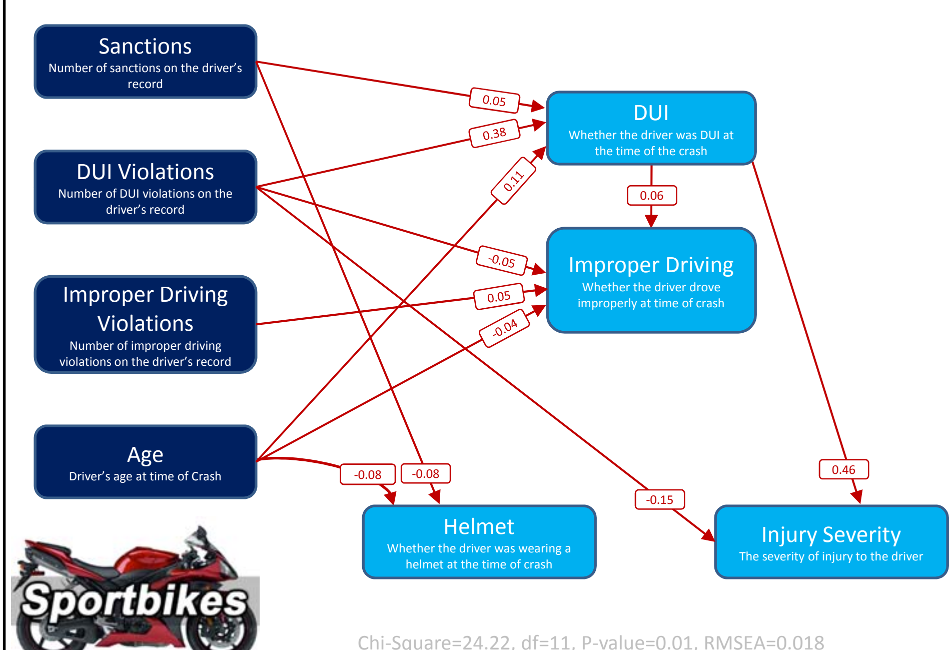
Model 32. Driving Record, Driver Actions (Inexperience), Fatality



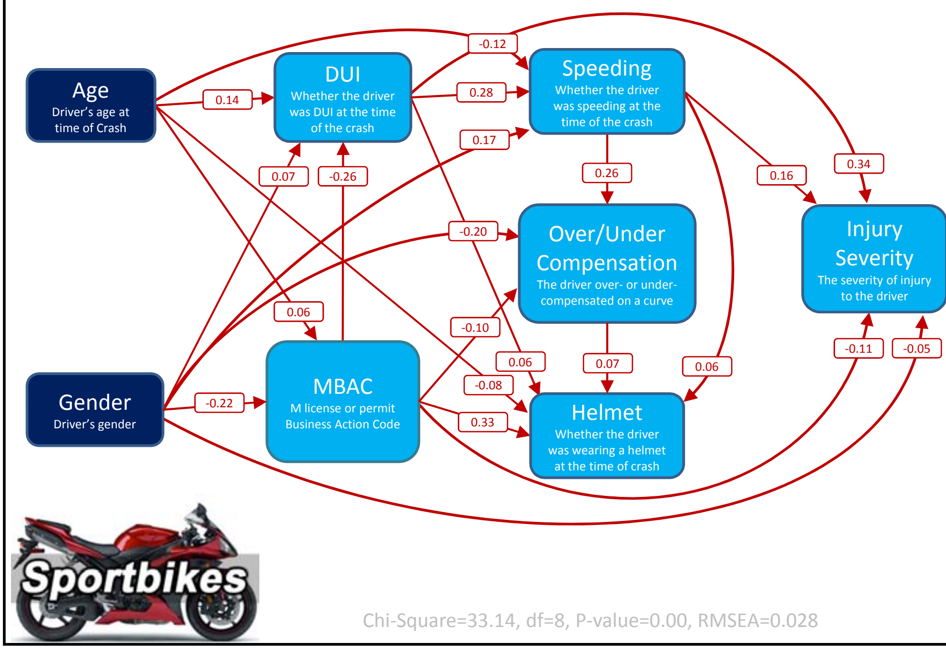
Model 33. Driving Record, Speeding, Severity



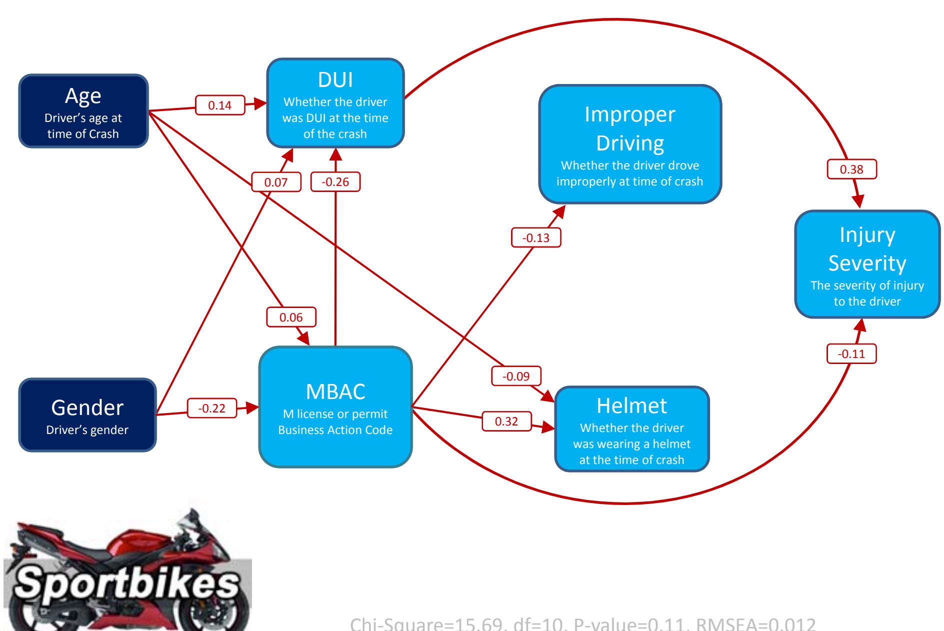
Model 34. Driving Record, Improper Driving, Severity



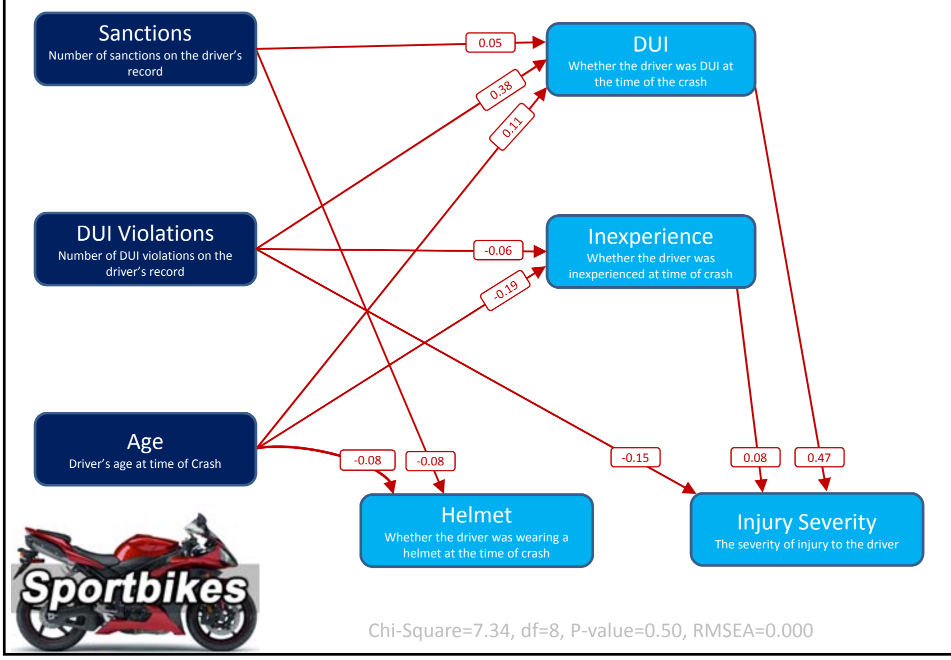
Model 35. Demographics, Driver Actions (Speeding, Over/Under Compensation), Severity



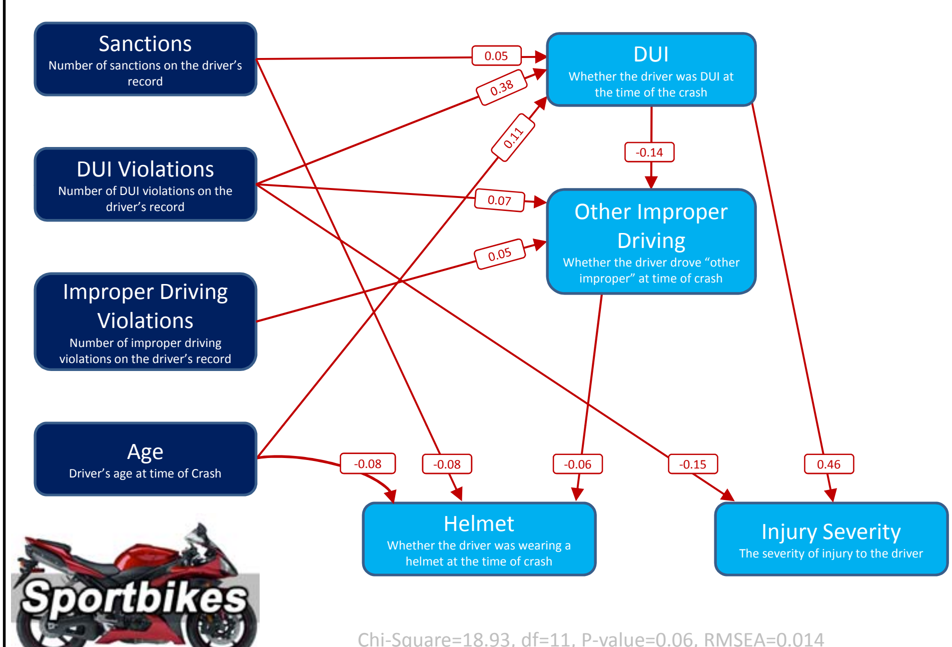
Model 36. Demographics, Driver Actions (Improper Driving), Severity

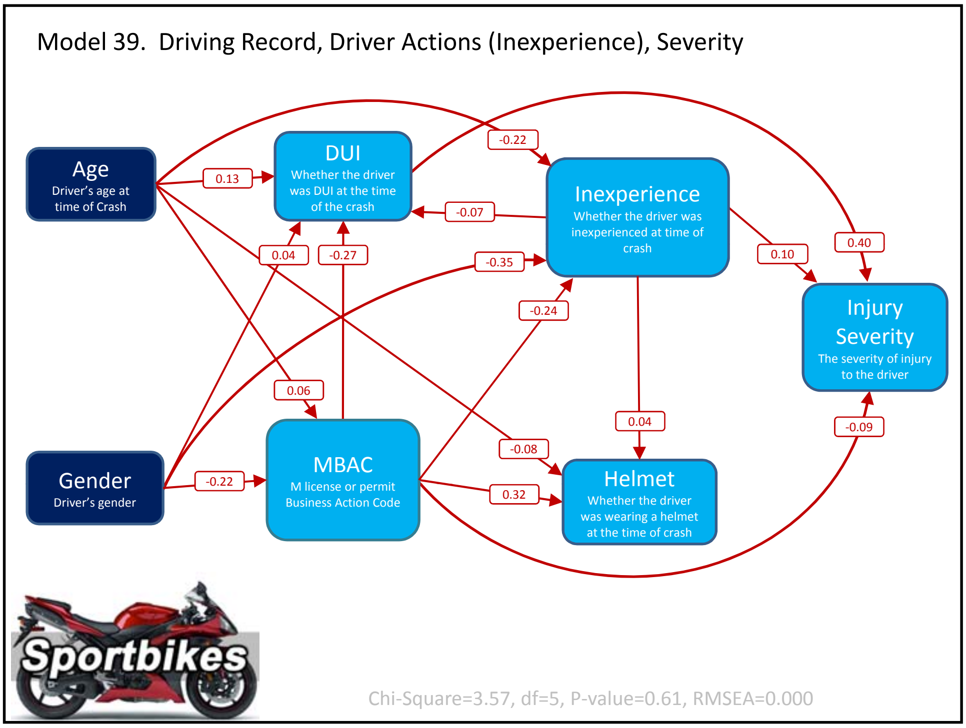


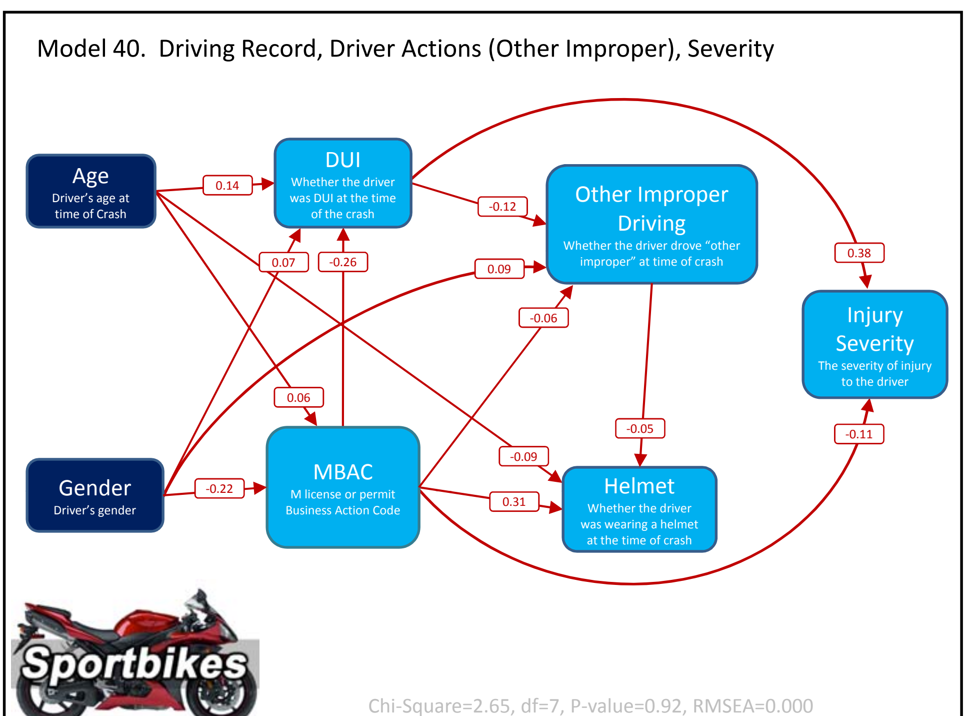
Model 37. Driving Record, Inexperience, Severity

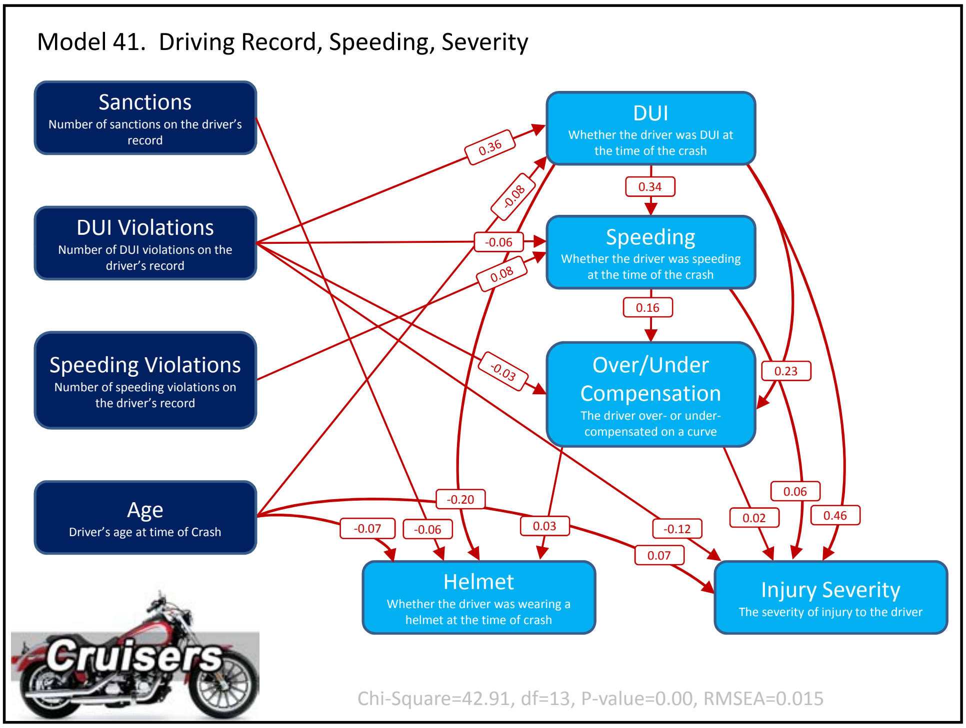


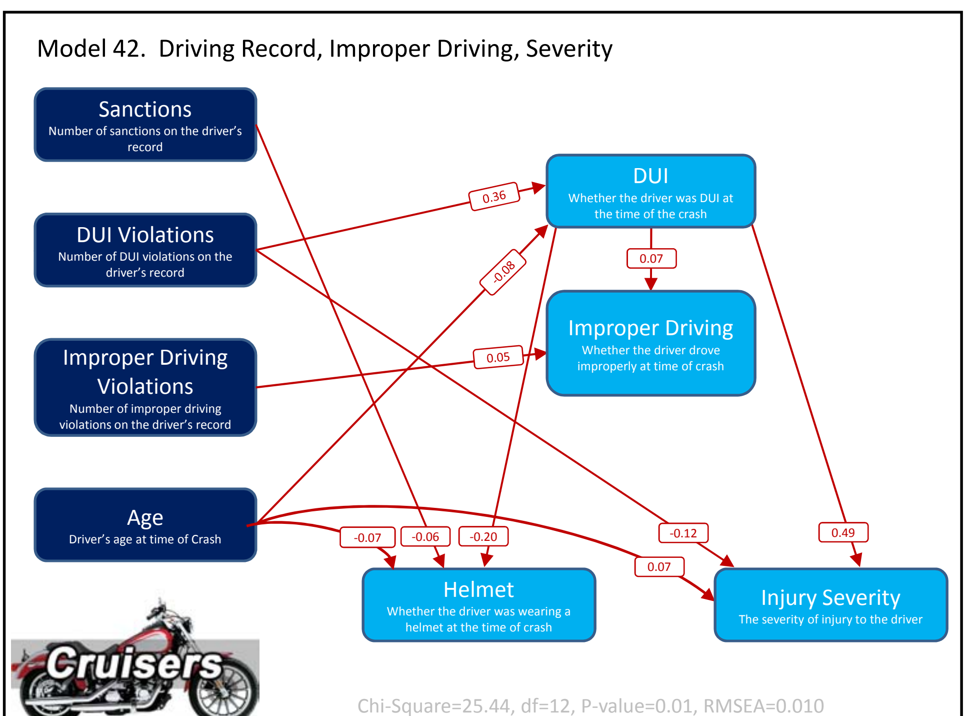
Model 38. Driving Record, Other Improper, Severity

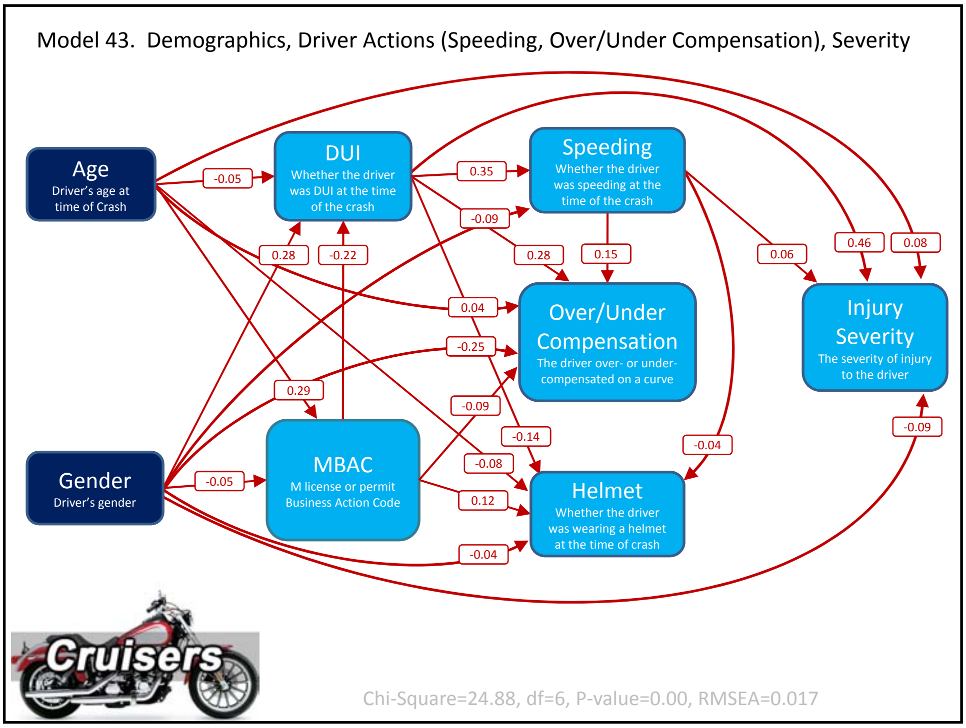



Model 39. Driving Record, Driver Actions (Inexperience), Severity
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Injury Severity
The severity of injury to the driver
Gender
Driver's gender
MBAC
M license or permit Business Action Code
Helmet
Whether the driver was wearing a helmet at the time of crash
0.13
-0.22
-0.07
0.04
-0.27
-0.35
0.10
0.40
-0.24
0.06
0.04
-0.09
-0.08
-0.22
0.32
Sportbikes
Chi-Square=3.57, df=5, P-value=0.61, RMSEA=0.000

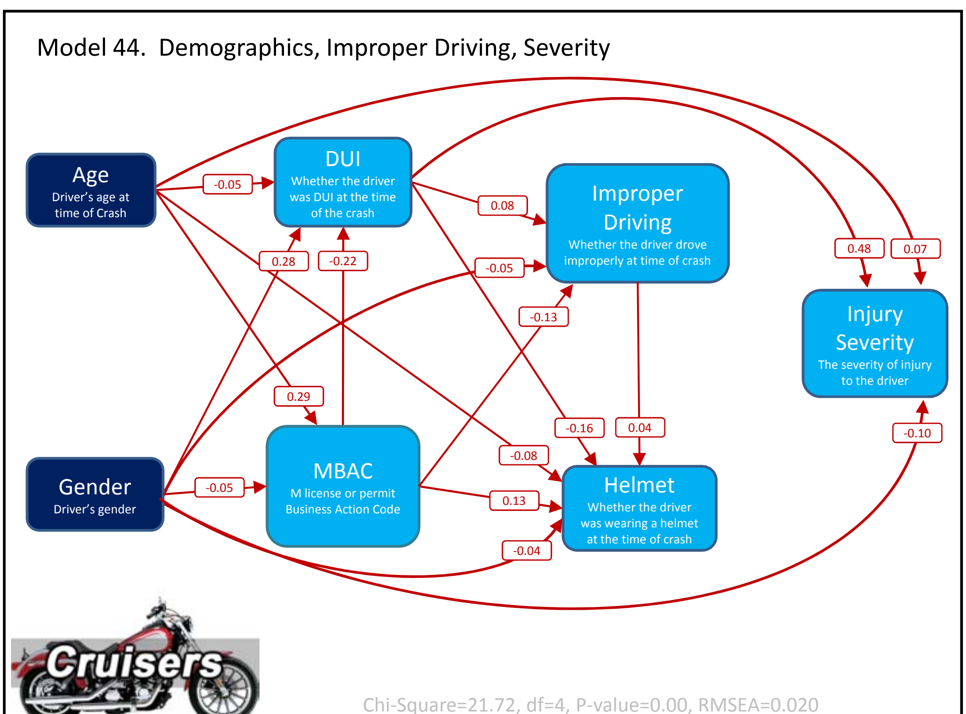

Model 40. Driving Record, Driver Actions (Other Improper), Severity
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Other Improper Driving
Whether the driver drove "other improper" at time of crash
Injury Severity
The severity of injury to the driver
Gender
Driver's gender
MBAC
M license or permit Business Action Code
Helmet
Whether the driver was wearing a helmet at the time of crash
0.14
-0.12
0.07
-0.26
0.09
0.38
-0.06
0.06
-0.05
-0.11
-0.09
-0.22
0.31
Sportbikes
Chi-Square=2.65, df=7, P-value=0.92, RMSEA=0.000


Model 41. Driving Record, Speeding, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Speeding Violations
Number of speeding violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Speeding
Whether the driver was speeding at the time of the crash
Over/Under Compensation
The driver over- or under-compensated on a curve
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.36
-0.08
0.34
-0.06
0.08
0.16
-0.03
0.23
-0.20
0.06
0.02
0.46
-0.07
-0.06
0.03
-0.12
0.07
Cruisers
Chi-Square=42.91, df=13, P-value=0.00, RMSEA=0.015


Model 42. Driving Record, Improper Driving, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.36
0.07
-0.08
0.05
-0.12
0.49
-0.07
-0.06
-0.20
0.07
Cruisers
Chi-Square=25.44, df=12, P-value=0.01, RMSEA=0.010

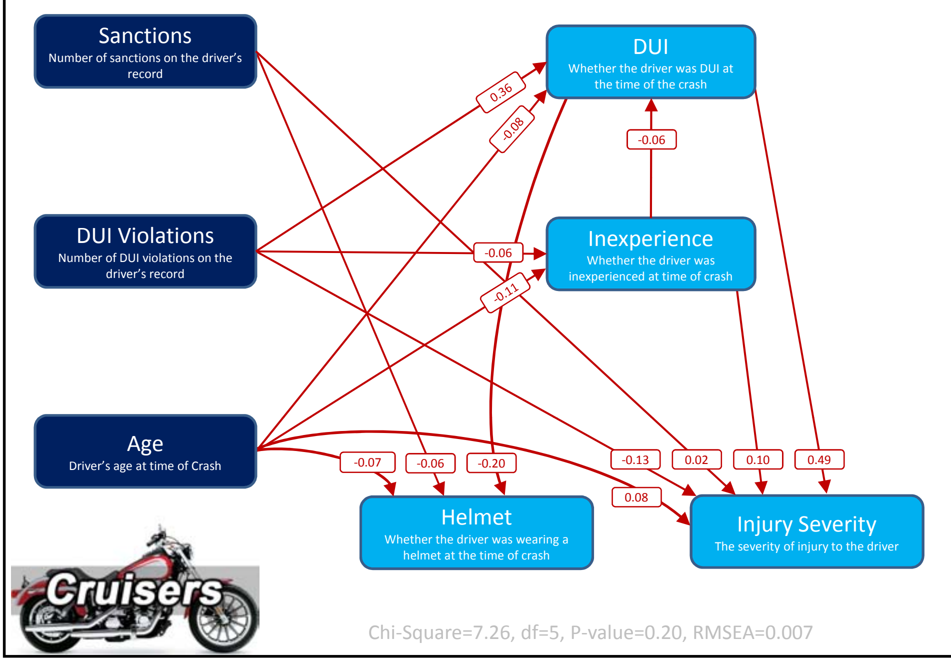


Model 43. Demographics, Driver Actions (Speeding, Over/Under Compensation), Severity
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Speeding
Whether the driver was speeding at the time of the crash
Over/Under Compensation
The driver over- or under-compensated on a curve
Injury Severity
The severity of injury to the driver
Gender
Driver's gender
MBAC
M license or permit Business Action Code
Helmet
Whether the driver was wearing a helmet at the time of crash
-0.05
0.35
-0.09
0.28
-0.22
0.28
0.15
0.06
0.46
0.08
0.04
-0.25
0.29
-0.09
-0.14
-0.04
-0.09
-0.08
-0.05
0.12
-0.04
Cruisers
Chi-Square=24.88, df=6, P-value=0.00, RMSEA=0.017

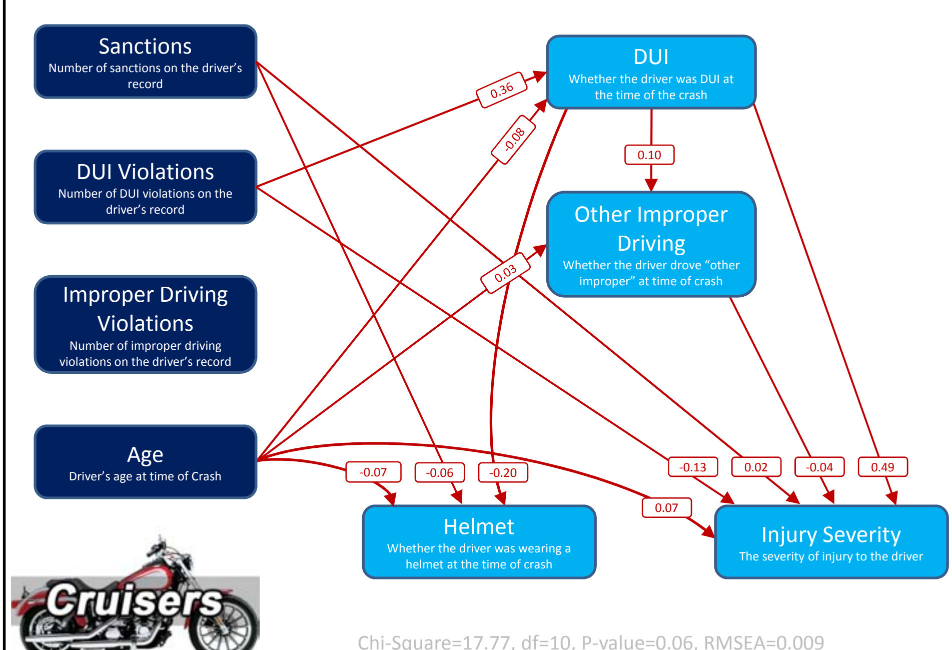


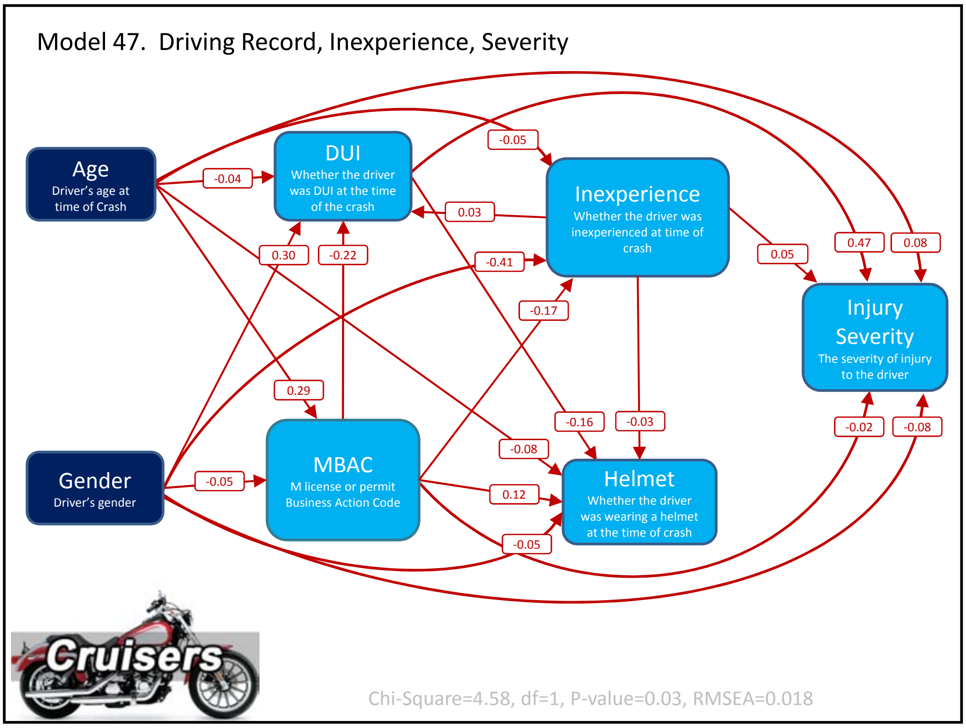
Model 44. Demographics, Improper Driving, Severity
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Injury Severity
The severity of injury to the driver
Gender
Driver's gender
MBAC
M license or permit Business Action Code
Helmet
Whether the driver was wearing a helmet at the time of crash
-0.05
0.08
0.28
-0.22
-0.05
-0.13
0.48
0.07
0.29
-0.16
0.04
-0.08
-0.05
0.13
-0.04
-0.10
Cruisers
Chi-Square=21.72, df=4, P-value=0.00, RMSEA=0.020

Model 45. Driving Record, Inexperience, Severity

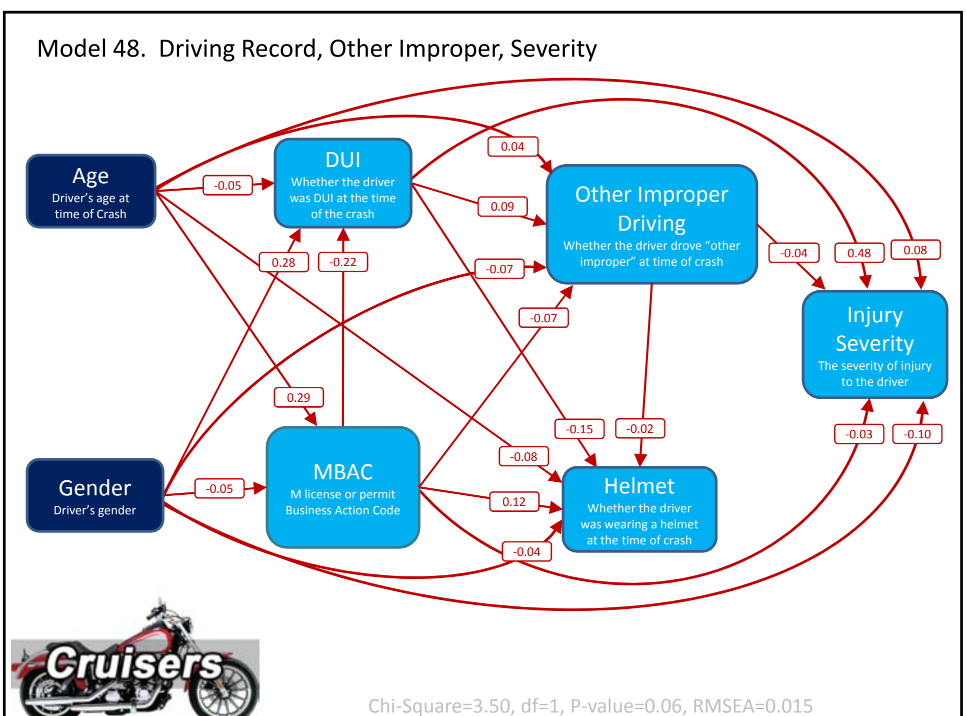


Model 46. Driving Record, Other Improper, Severity



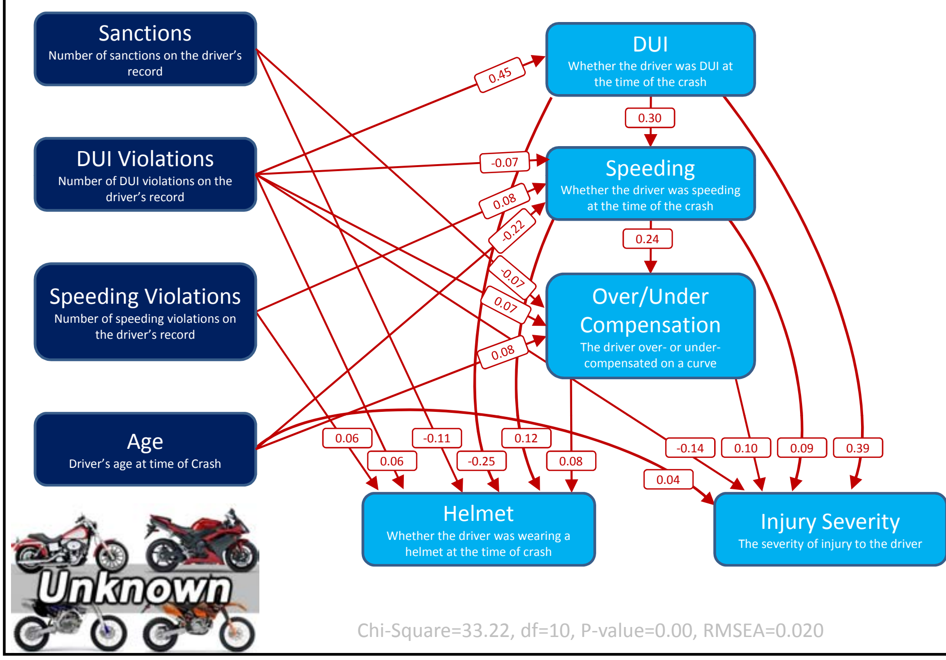


Model 47. Driving Record, Inexperience, Severity
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Injury Severity
The severity of injury to the driver
Gender
Driver's gender
MBAC
M license or permit Business Action Code
Helmet
Whether the driver was wearing a helmet at the time of crash
-0.04
-0.05
0.03
0.30
-0.22
-0.41
-0.17
0.05
0.47
0.08
0.29
-0.16
-0.03
-0.08
-0.05
0.12
-0.05
-0.02
-0.08
Cruisers
Chi-Square=4.58, df=1, P-value=0.03, RMSEA=0.018

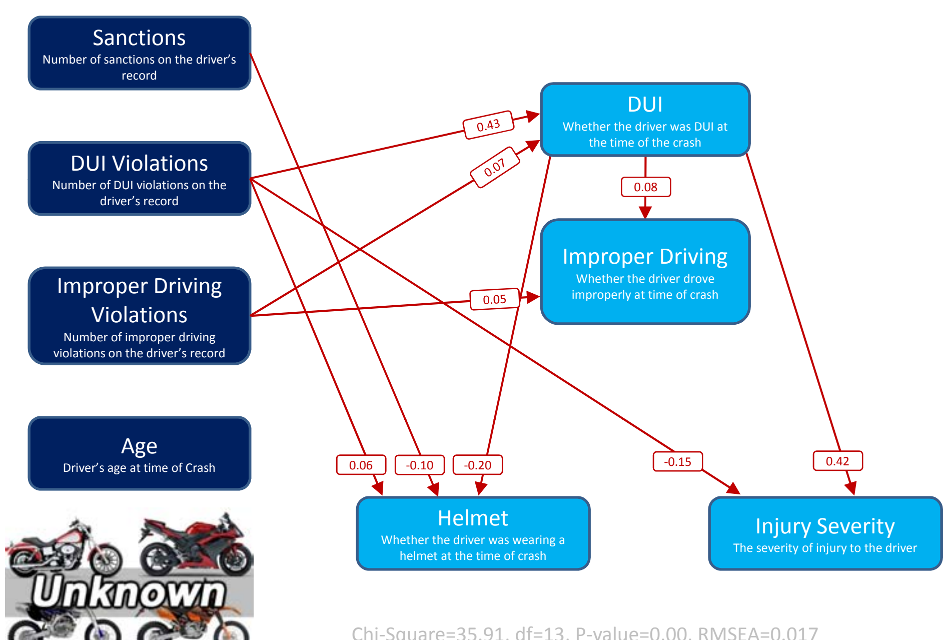


Model 48. Driving Record, Other Improper, Severity
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Other Improper Driving
Whether the driver drove "other improper" at time of crash
Injury Severity
The severity of injury to the driver
Gender
Driver's gender
MBAC
M license or permit Business Action Code
Helmet
Whether the driver was wearing a helmet at the time of crash
-0.05
0.04
0.09
0.28
-0.22
-0.07
-0.07
-0.04
0.48
0.08
0.29
-0.15
-0.02
-0.08
-0.05
0.12
-0.04
-0.03
-0.10
Cruisers
Chi-Square=3.50, df=1, P-value=0.06, RMSEA=0.015

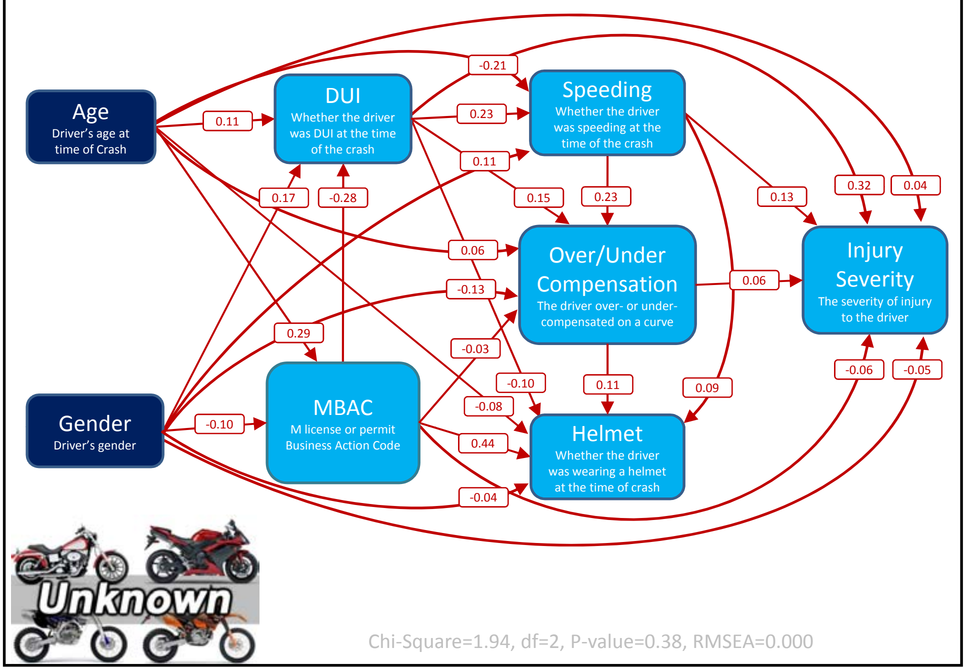
Model 49. Driving Record, Speeding, Severity



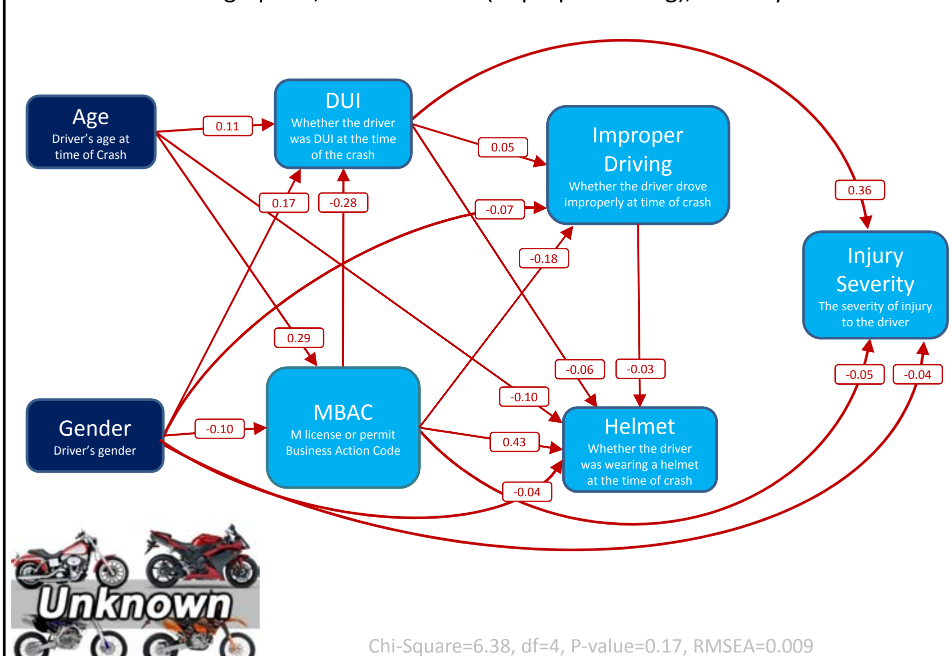
Model 50. Driving Record, Improper Driving, Severity



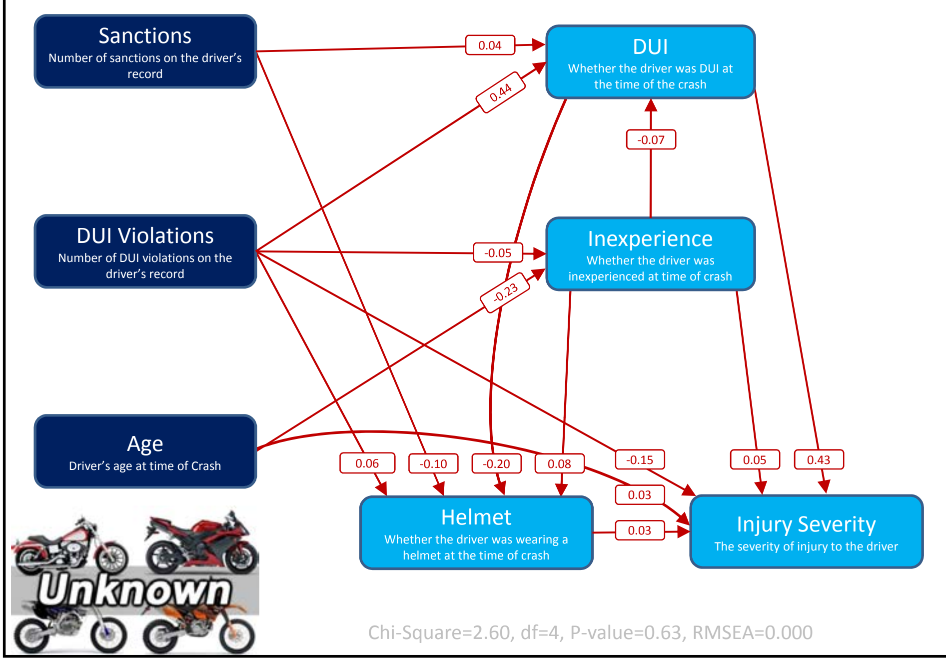
Model 51. Demographics, Driver Actions (Speeding, Over/Under Compensation), Severity



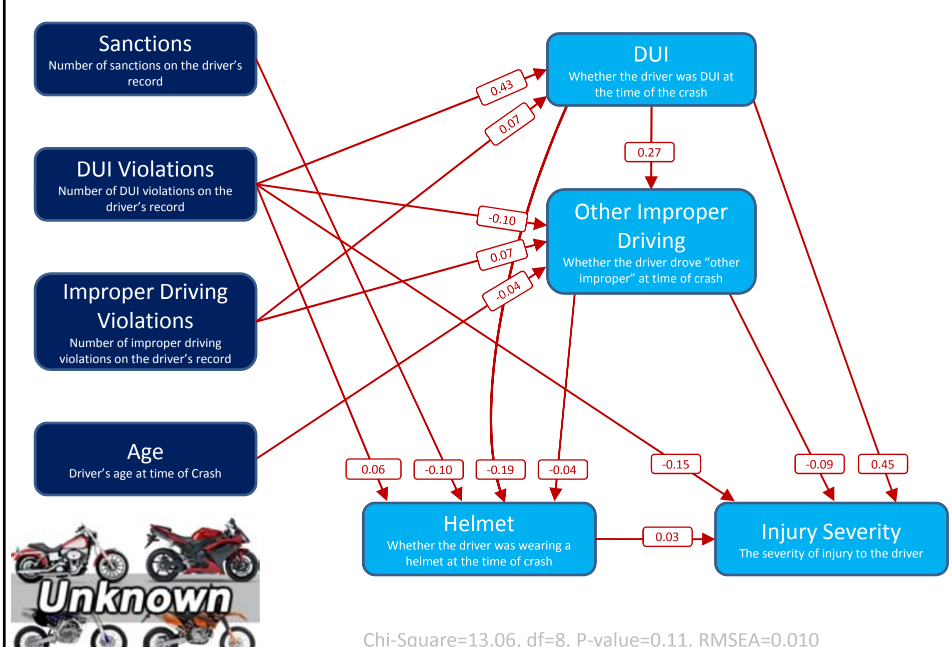
Model 52. Demographics, Driver Actions (Improper Driving), Severity



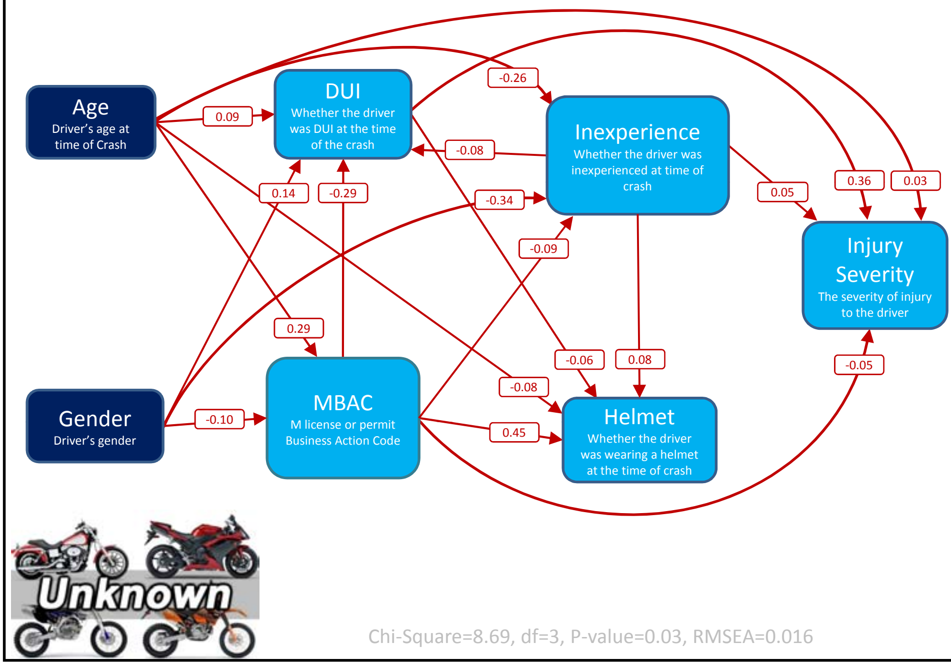
Model 53. Driving Record, Inexperience, Severity



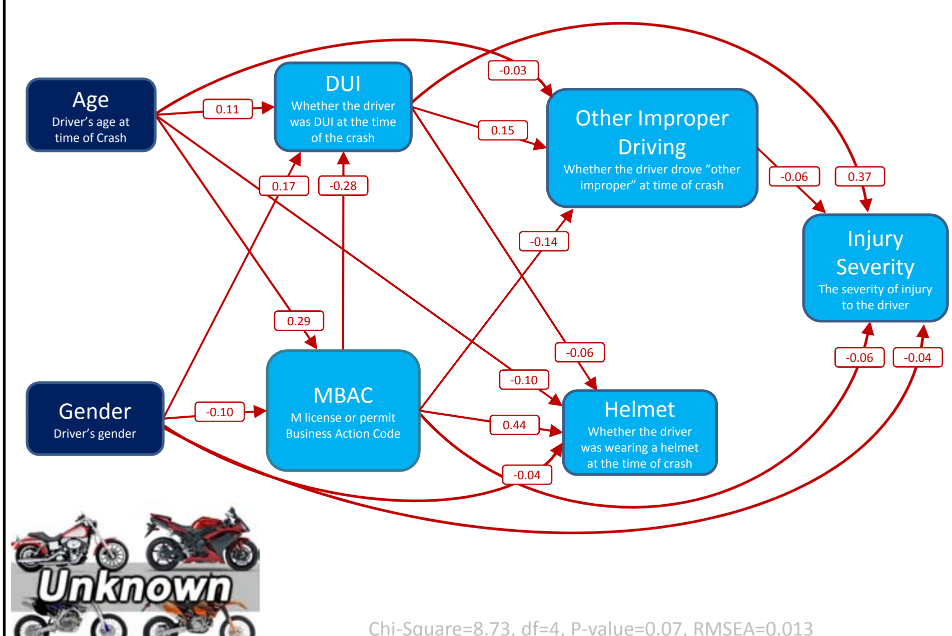
Model 54. Driving Record, Other Improper, Severity

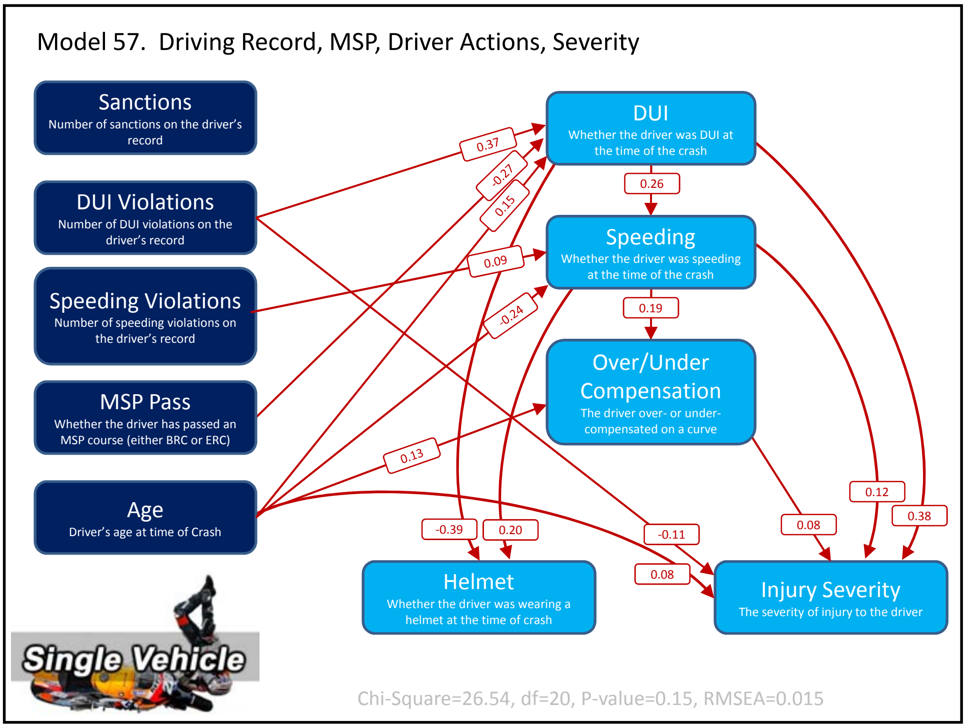


Model 55. Driving Record, Driver Actions (Inexperience), Severity

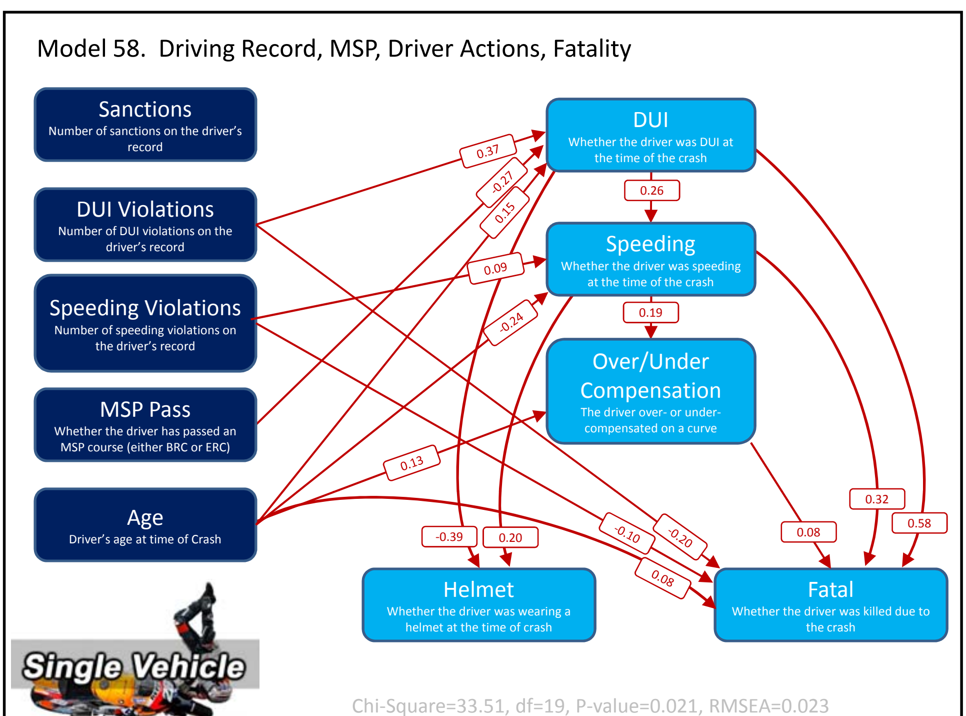


Model 56. Driving Record, Driver Actions (Other Improper), Severity

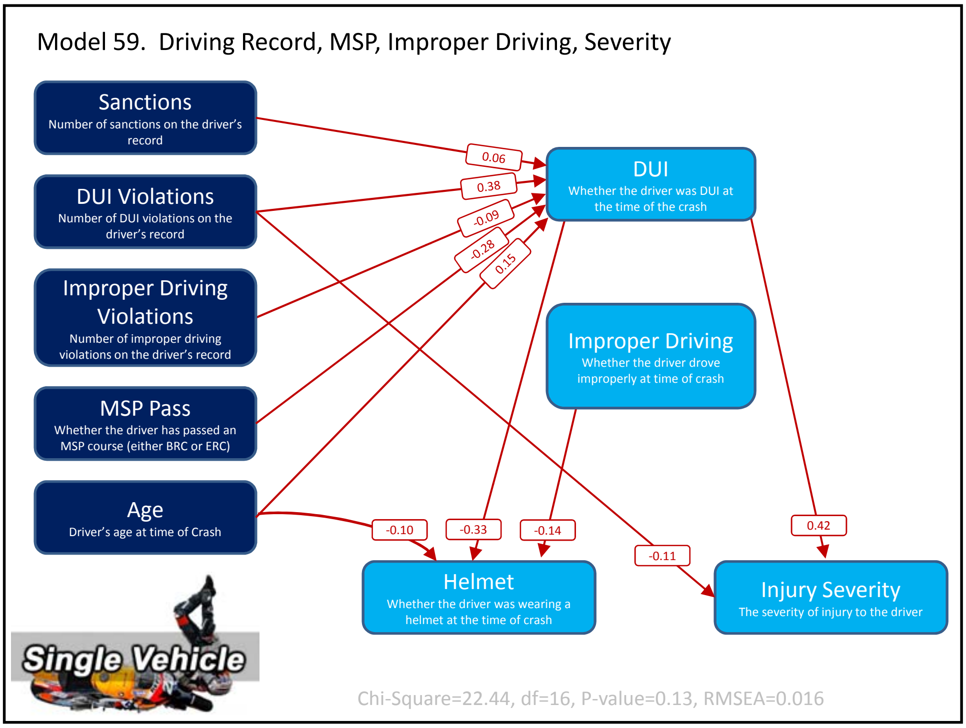


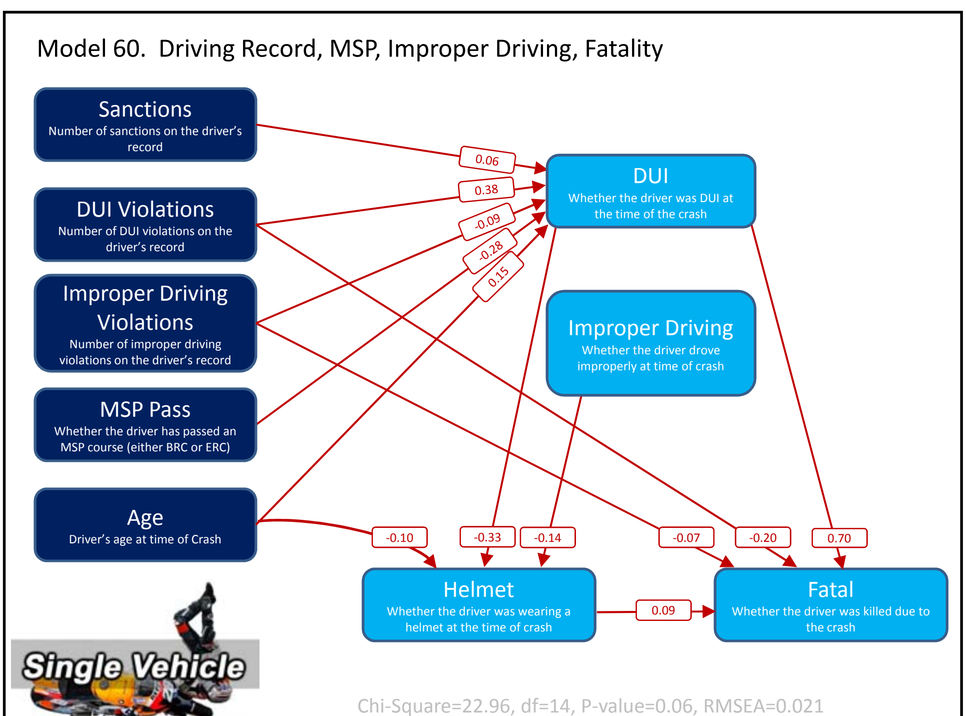


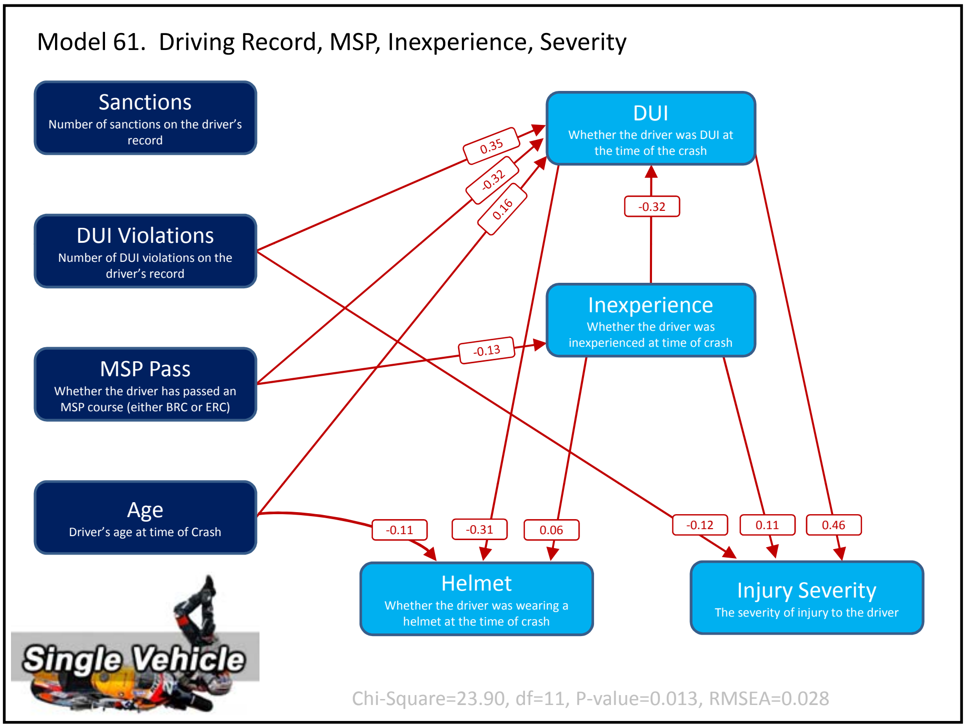
Model 57. Driving Record, MSP, Driver Actions, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Speeding Violations
Number of speeding violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Speeding
Whether the driver was speeding at the time of the crash
Over/Under Compensation
The driver over- or under-compensated on a curve
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.37
-0.27
0.15
0.26
0.09
-0.24
0.19
0.13
-0.39
0.20
-0.11
0.08
0.08
0.12
0.38
Single Vehicle
Chi-Square=26.54, df=20, P-value=0.15, RMSEA=0.015

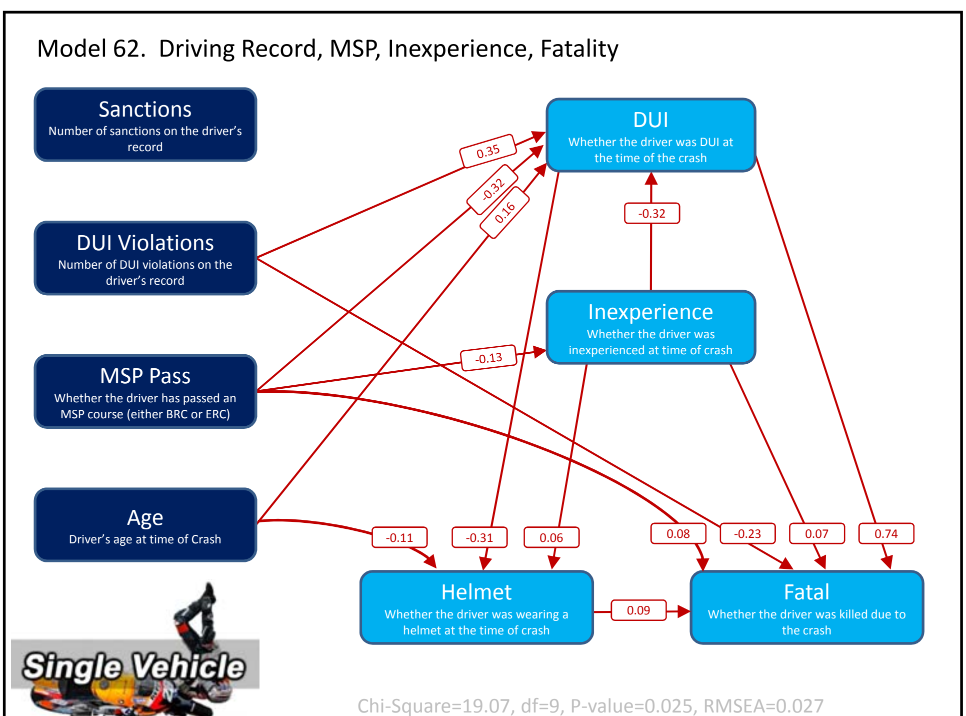


Model 58. Driving Record, MSP, Driver Actions, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Speeding Violations
Number of speeding violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Speeding
Whether the driver was speeding at the time of the crash
Over/Under Compensation
The driver over- or under-compensated on a curve
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.37
-0.27
0.15
0.26
0.09
-0.24
0.19
0.13
-0.39
0.20
-0.10
-0.20
0.08
0.08
0.32
0.58
Single Vehicle
Chi-Square=33.51, df=19, P-value=0.021, RMSEA=0.023

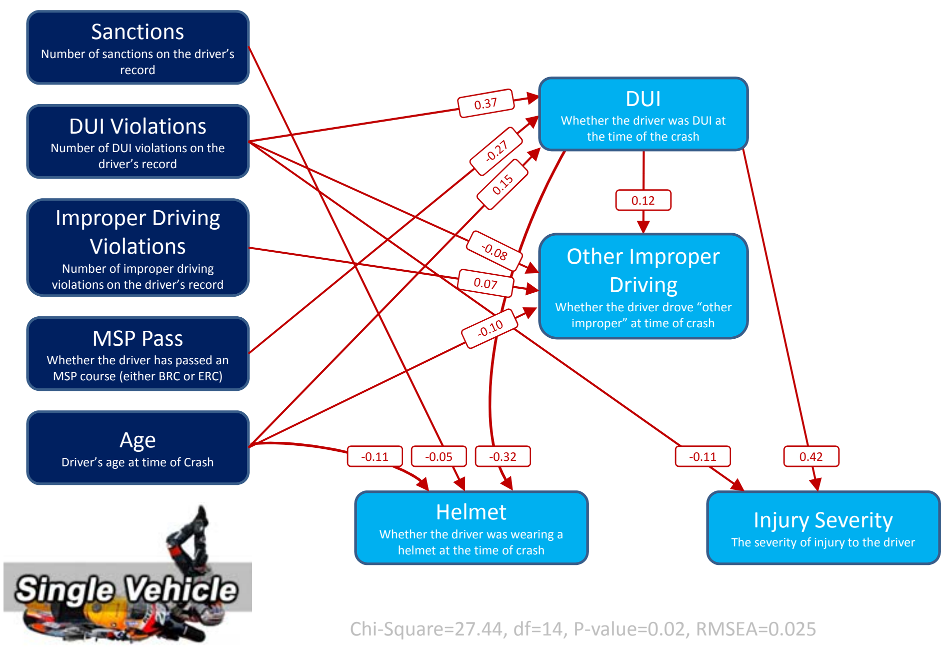

Model 59. Driving Record, MSP, Improper Driving, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.06
0.38
-0.09
-0.28
0.15
-0.10
-0.33
-0.14
-0.11
0.42
Single Vehicle
Chi-Square=22.44, df=16, P-value=0.13, RMSEA=0.016


Model 60. Driving Record, MSP, Improper Driving, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.06
0.38
-0.09
-0.28
0.15
-0.10
-0.33
-0.14
-0.07
-0.20
0.70
0.09
Single Vehicle
Chi-Square=22.96, df=14, P-value=0.06, RMSEA=0.021

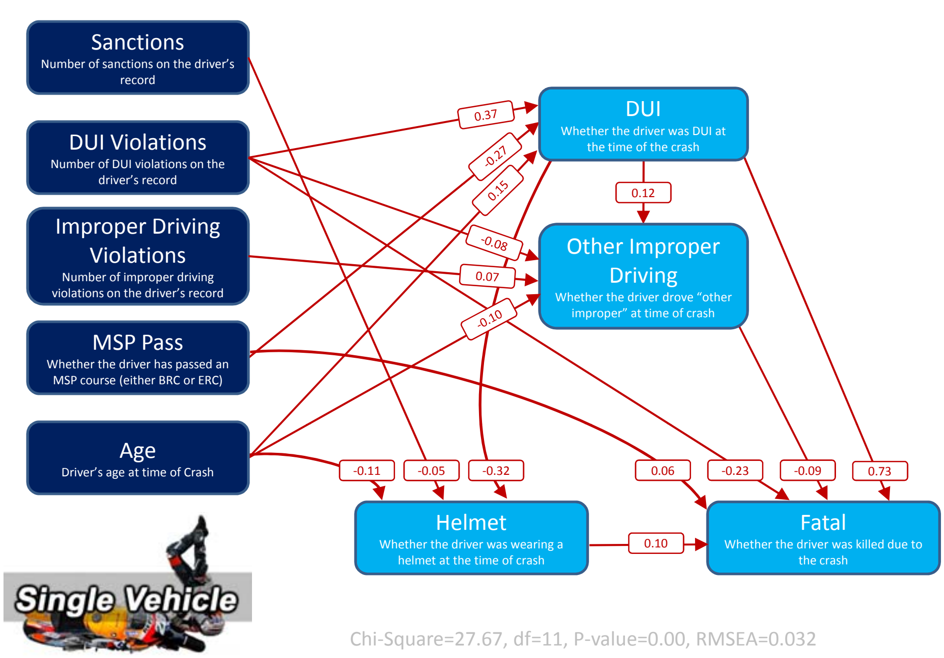

Model 61. Driving Record, MSP, Inexperience, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.35
-0.32
0.16
-0.32
-0.13
-0.11
-0.31
0.06
-0.12
0.11
0.46
Single Vehicle
Chi-Square=23.90, df=11, P-value=0.013, RMSEA=0.028


Model 62. Driving Record, MSP, Inexperience, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.35
-0.32
0.16
-0.32
-0.13
-0.11
-0.31
0.06
0.08
-0.23
0.07
0.74
0.09
Single Vehicle
Chi-Square=19.07, df=9, P-value=0.025, RMSEA=0.027

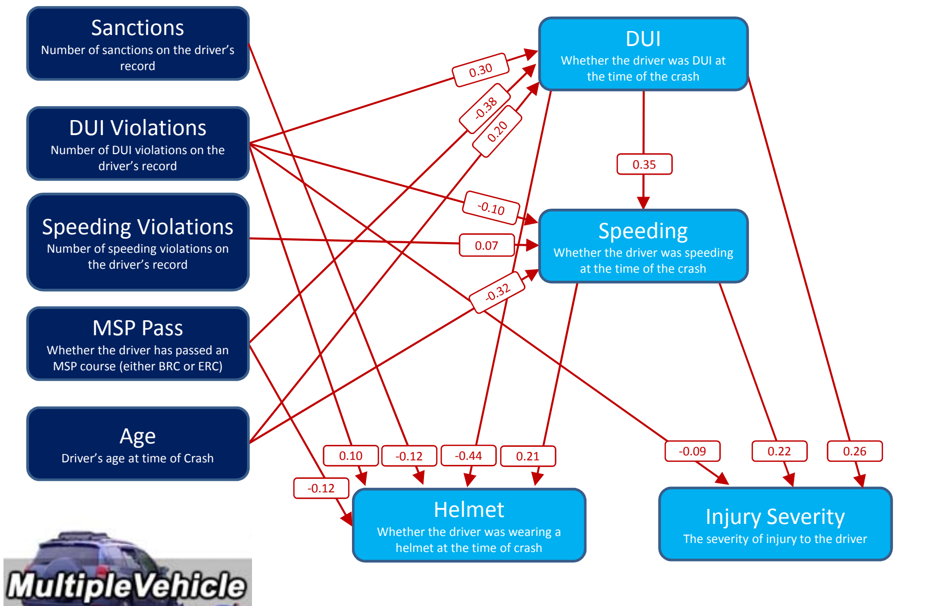
Model 63. Driving Record, MSP, Other Improper, Severity



Model 64. Driving Record, MSP, Other Improper, Fatality

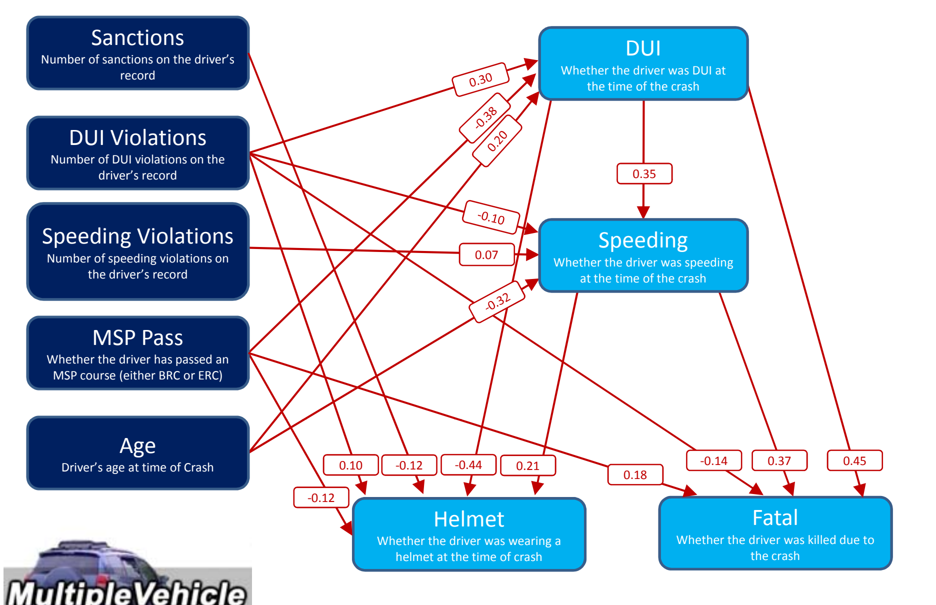


Model 65. Driving Record, MSP, Driver Actions, Severity

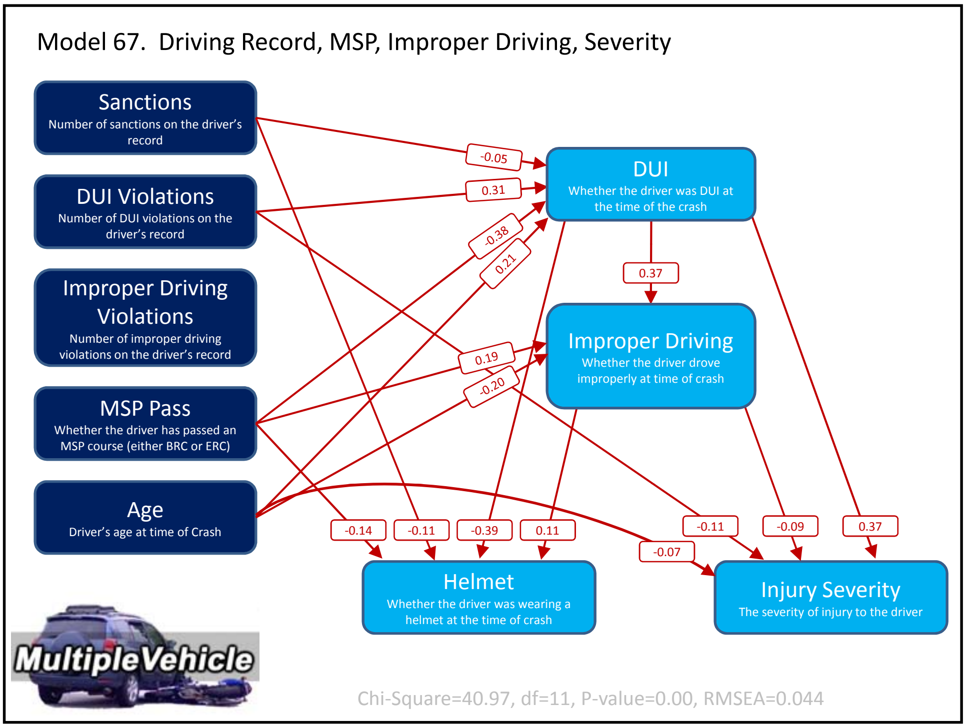


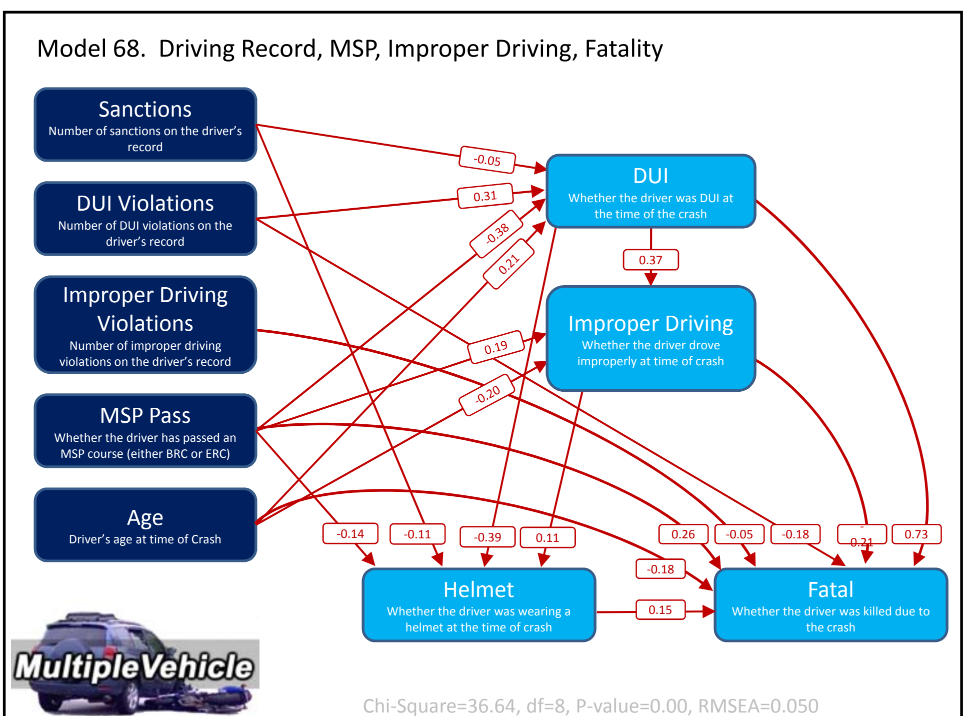
Chi-Square=17.47, df=11, P-value=0.095, RMSEA=0.020

Model 66. Driving Record, MSP, Driver Actions, Fatality

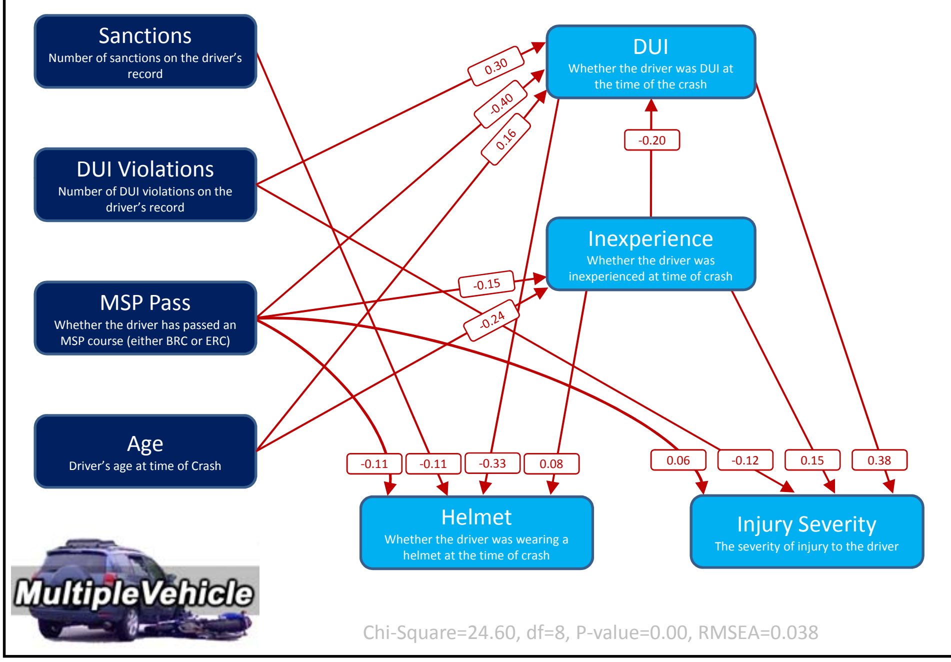


Chi-Square=30.29, df=10, P-value=0.00, RMSEA=0.038

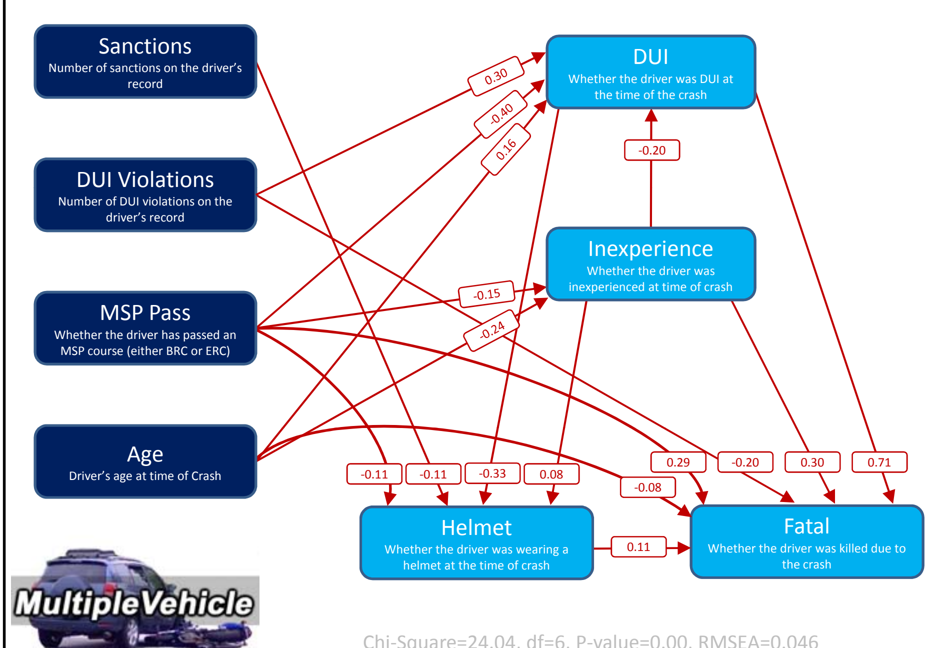

Model 67. Driving Record, MSP, Improper Driving, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
-0.05
0.31
-0.38
0.21
0.37
0.19
-0.20
-0.14
-0.11
-0.39
0.11
-0.11
-0.09
0.37
-0.07
MultipleVehicle
Chi-Square=40.97, df=11, P-value=0.00, RMSEA=0.044

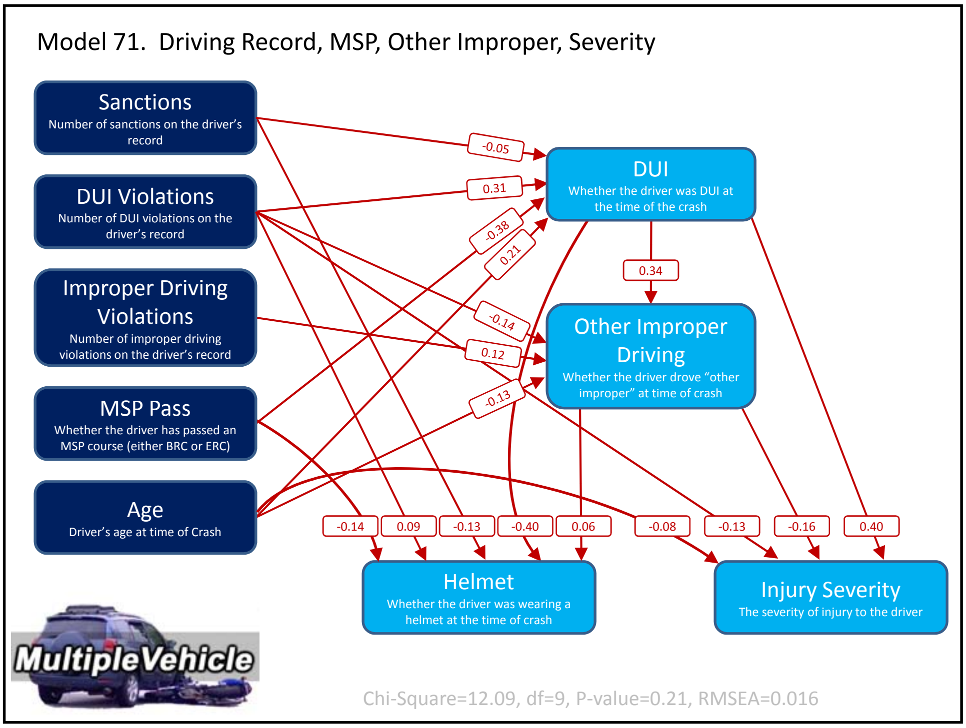

Model 68. Driving Record, MSP, Improper Driving, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
-0.05
0.31
-0.38
0.21
0.37
0.19
-0.20
-0.14
-0.11
-0.39
0.11
0.26
-0.05
-0.18
-0.21
0.73
-0.18
0.15
MultipleVehicle
Chi-Square=36.64, df=8, P-value=0.00, RMSEA=0.050

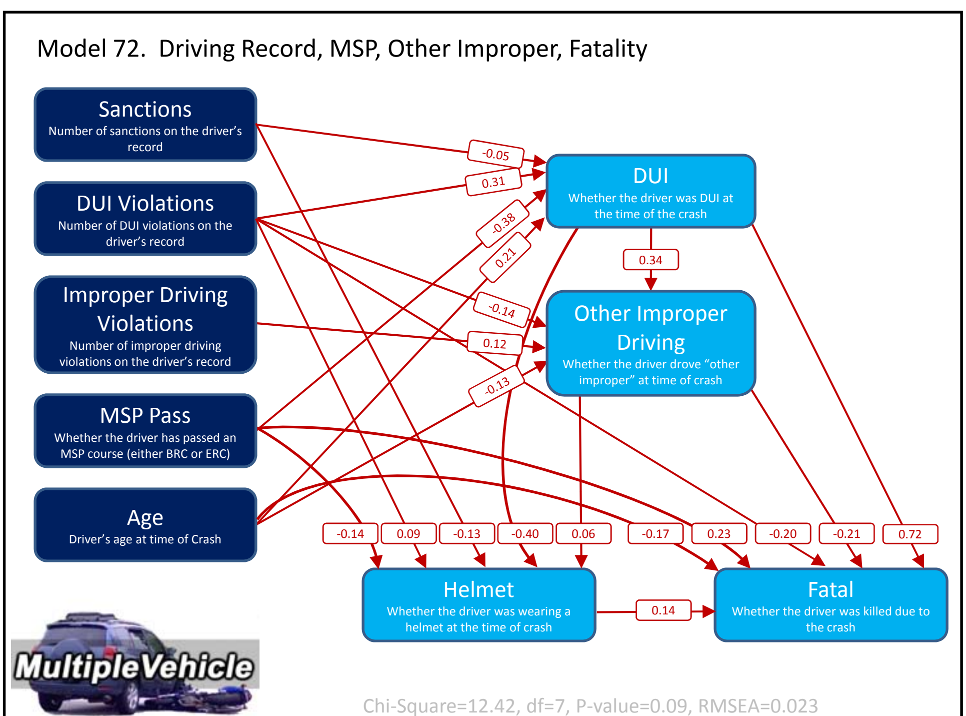
Model 69. Driving Record, MSP, Inexperience, Severity



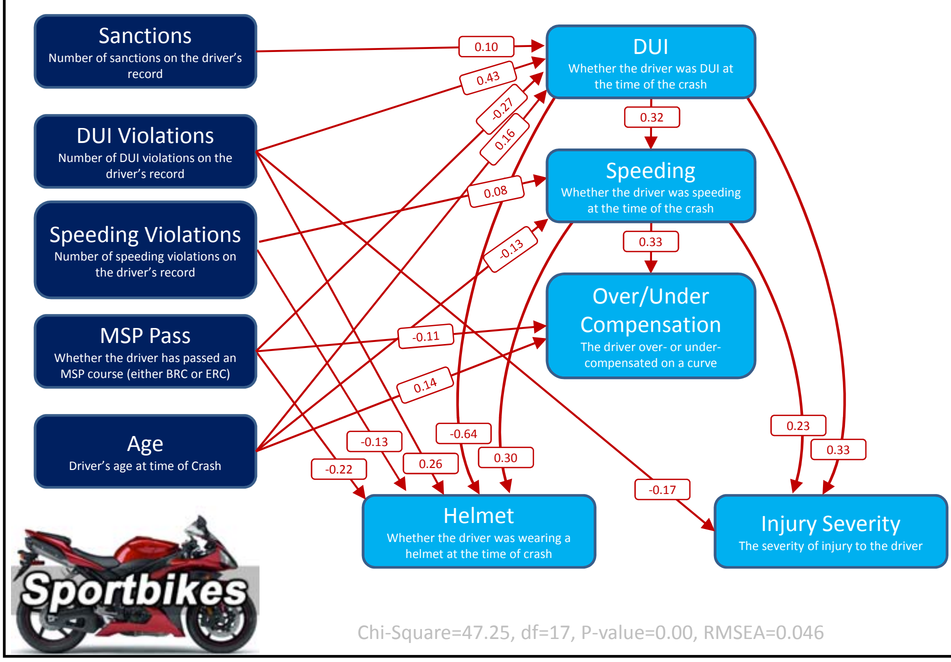
Model 70. Driving Record, MSP, Inexperience, Fatality



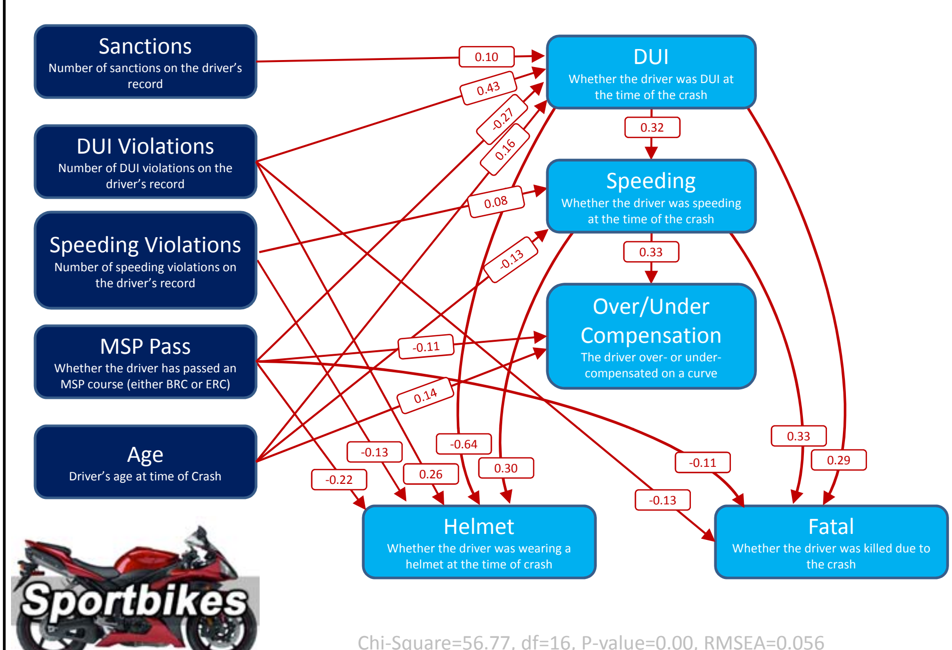

Model 71. Driving Record, MSP, Other Improper, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Other Improper Driving
Whether the driver drove "other improper" at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
-0.05
0.31
-0.38
0.21
0.34
-0.14
0.12
-0.13
-0.14
0.09
-0.13
-0.40
0.06
-0.08
-0.13
-0.16
0.40
MultipleVehicle
Chi-Square=12.09, df=9, P-value=0.21, RMSEA=0.016


Model 72. Driving Record, MSP, Other Improper, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Other Improper Driving
Whether the driver drove "other improper" at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
-0.05
0.31
-0.38
0.21
0.34
-0.14
0.12
-0.13
-0.14
0.09
-0.13
-0.40
0.06
-0.17
0.23
-0.20
-0.21
0.72
0.14
MultipleVehicle
Chi-Square=12.42, df=7, P-value=0.09, RMSEA=0.023

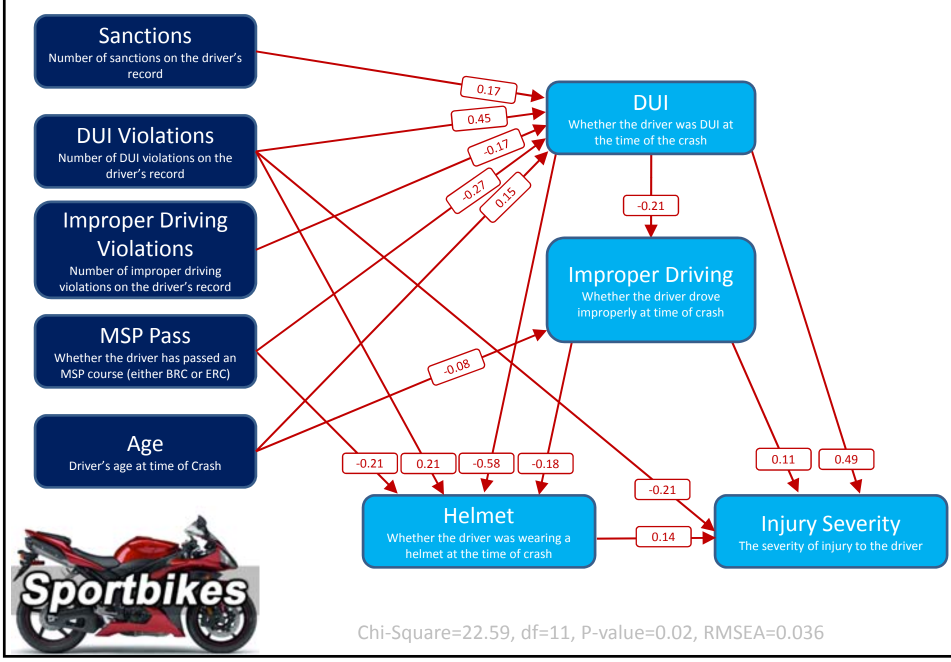
Model 73. Driving Record, MSP, Driver Actions, Severity



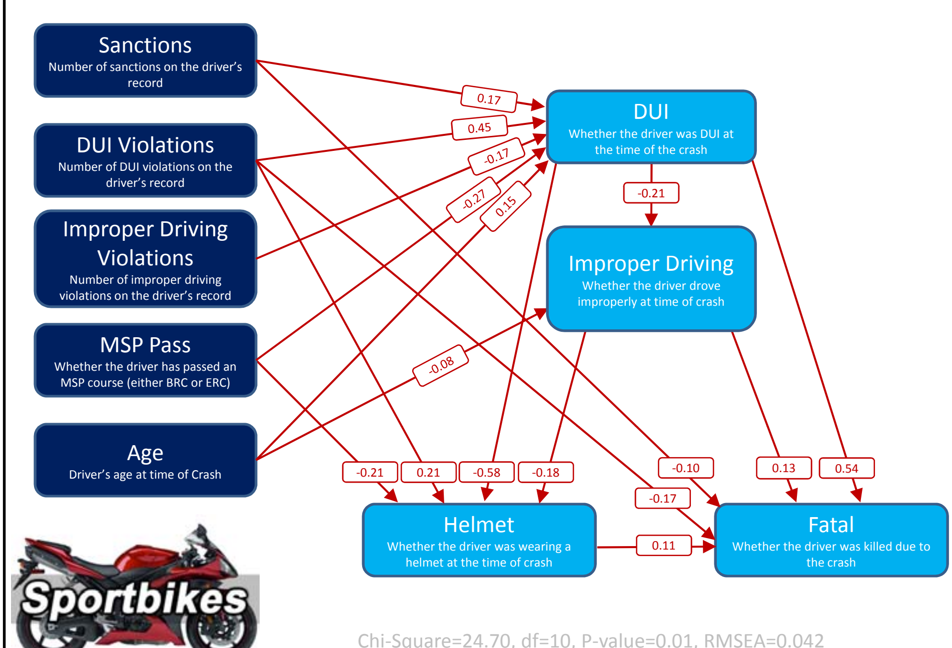
Model 74. Driving Record, MSP, Driver Actions, Fatility

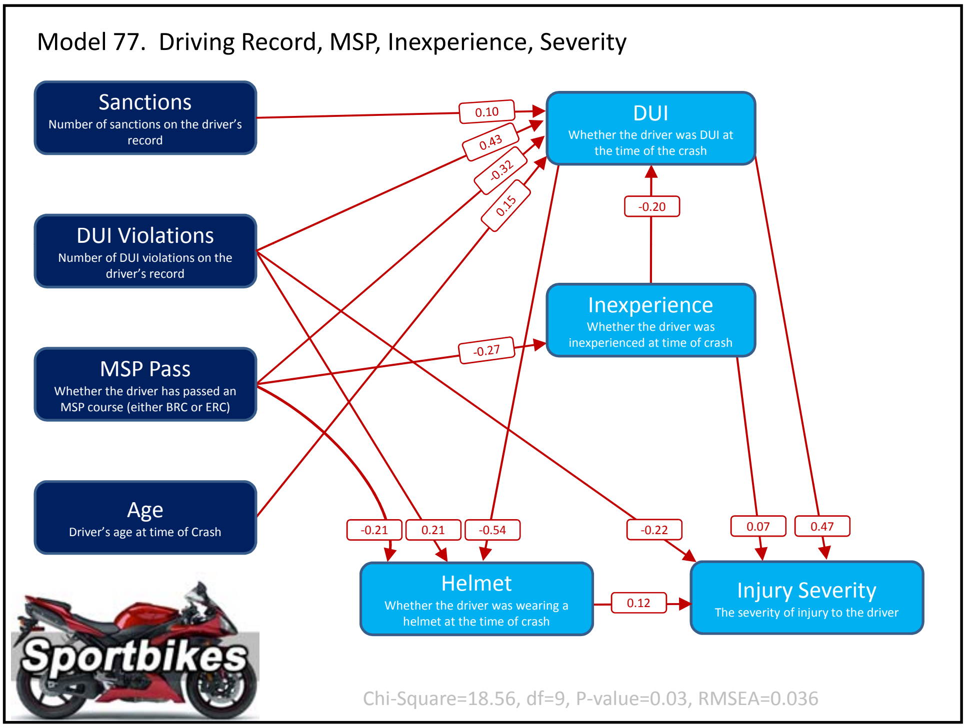


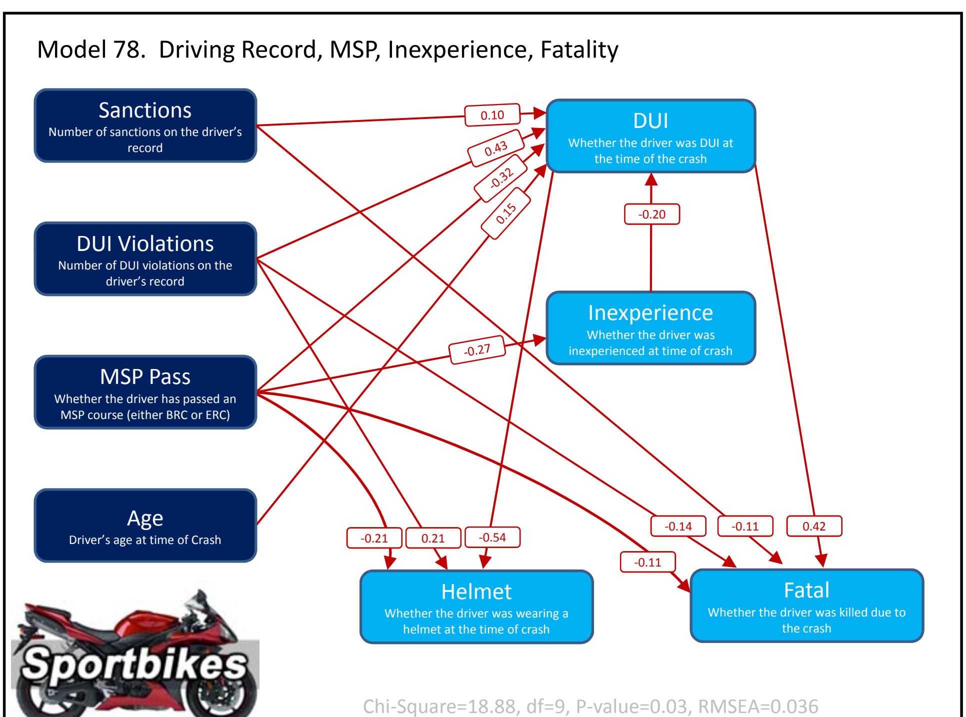
Model 75. Driving Record, MSP, Driver Actions, Severity



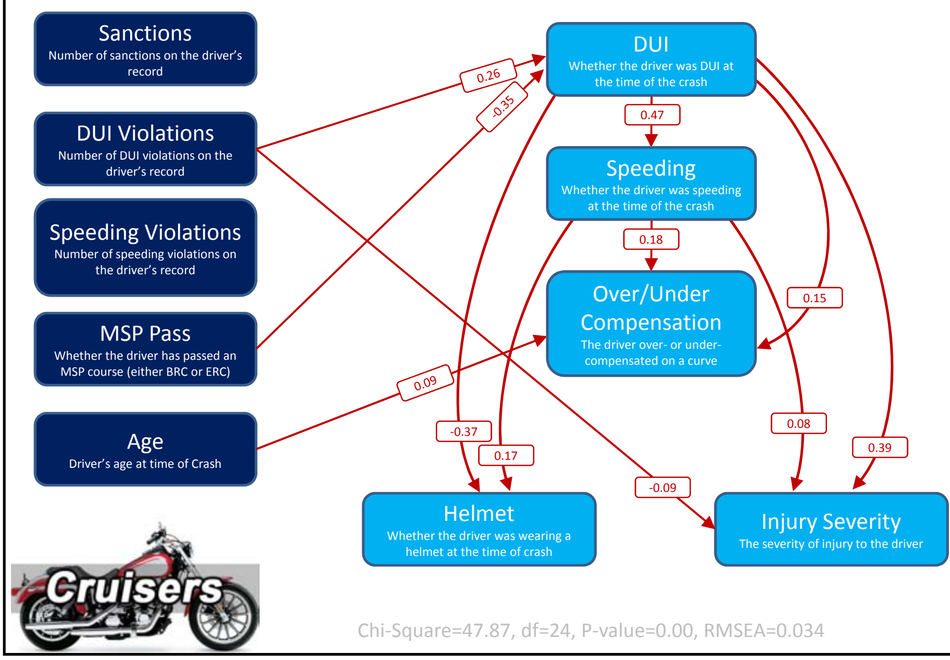
Model 76. Driving Record, MSP, Driver Actions, Fatality




Model 77. Driving Record, MSP, Inexperience, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.10
0.43
-0.32
0.15
-0.20
-0.27
-0.21
0.21
-0.54
-0.22
0.07
0.47
0.12
Sportbikes
Chi-Square=18.56, df=9, P-value=0.03, RMSEA=0.036

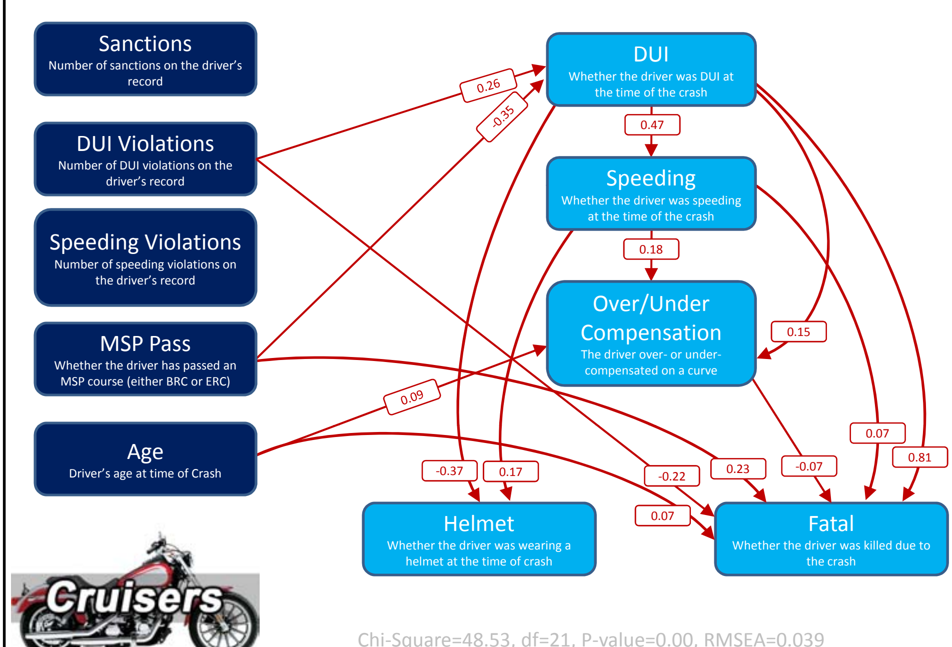

Model 78. Driving Record, MSP, Inexperience, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.10
0.43
-0.32
0.15
-0.20
-0.27
-0.21
0.21
-0.54
-0.14
-0.11
0.42
-0.11
Sportbikes
Chi-Square=18.88, df=9, P-value=0.03, RMSEA=0.036

Model 81. Driving Record, MSP, Driver Actions, Severity

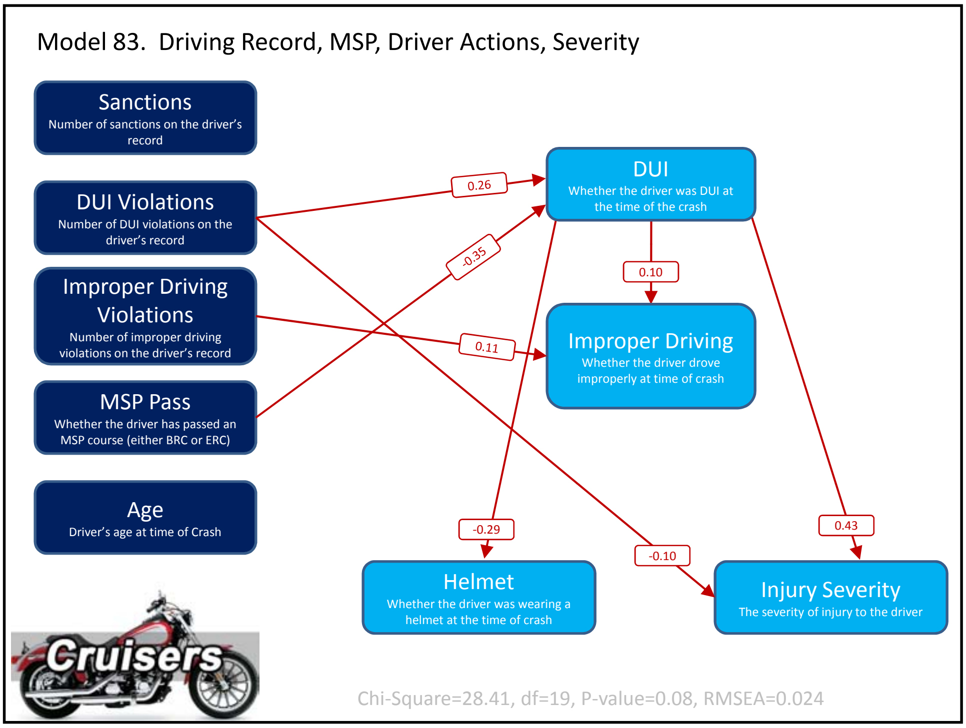


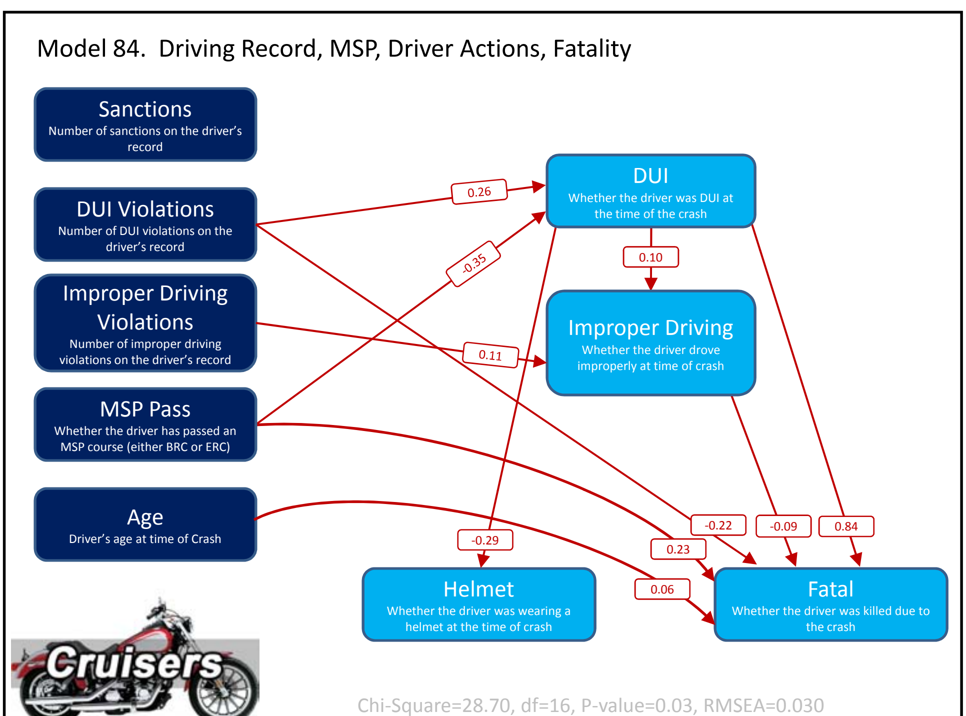
Chi-Square=47.87, df=24, P-value=0.00, RMSEA=0.034

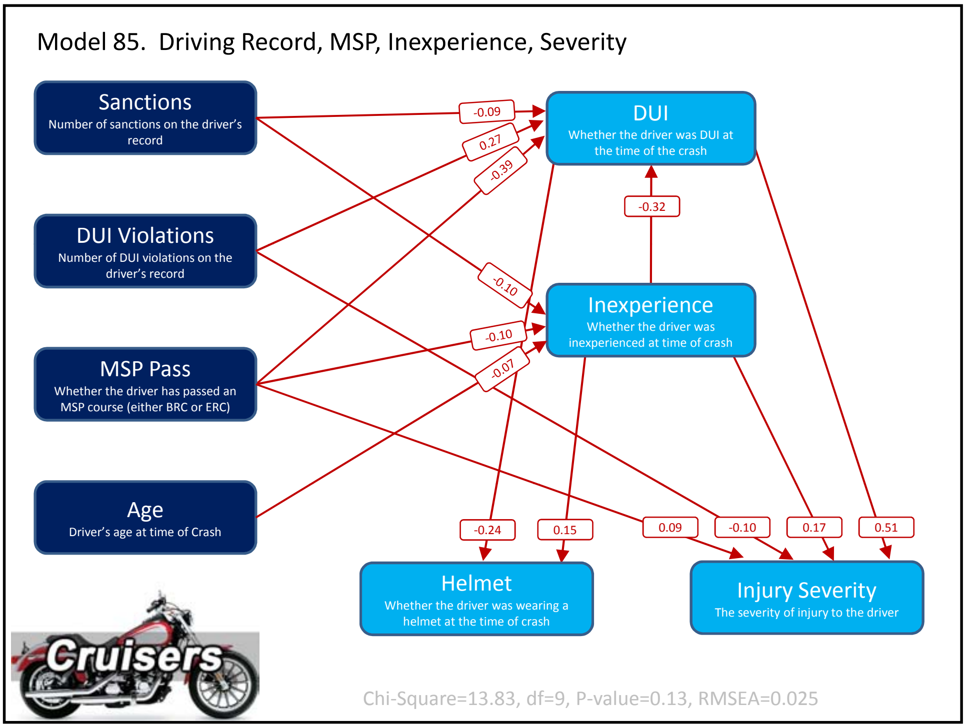
Model 82. Driving Record, MSP, Driver Actions, Fatility

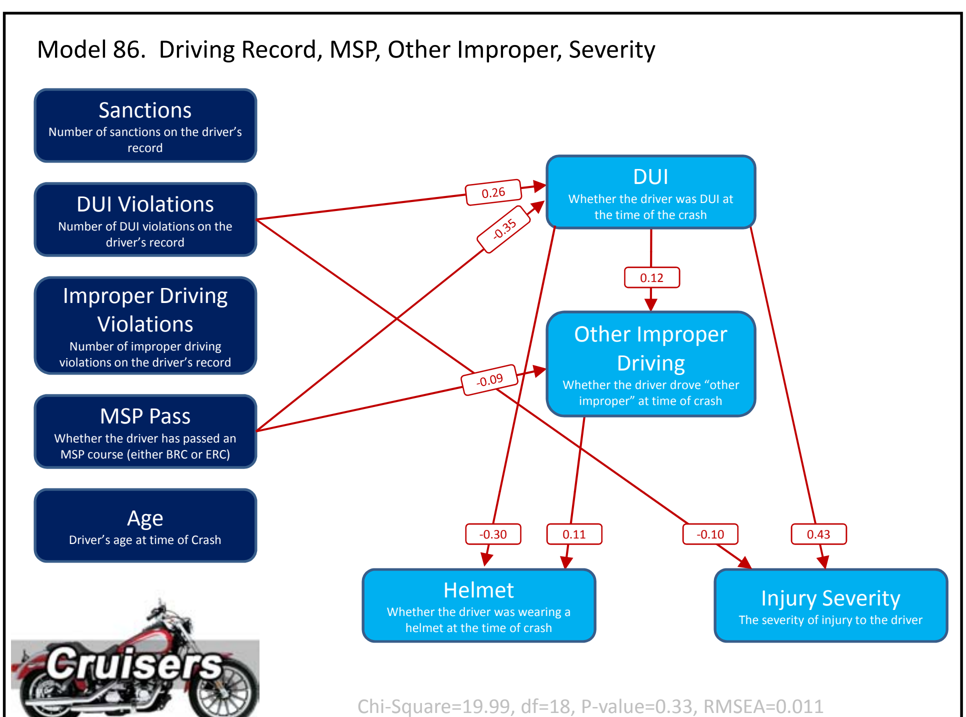


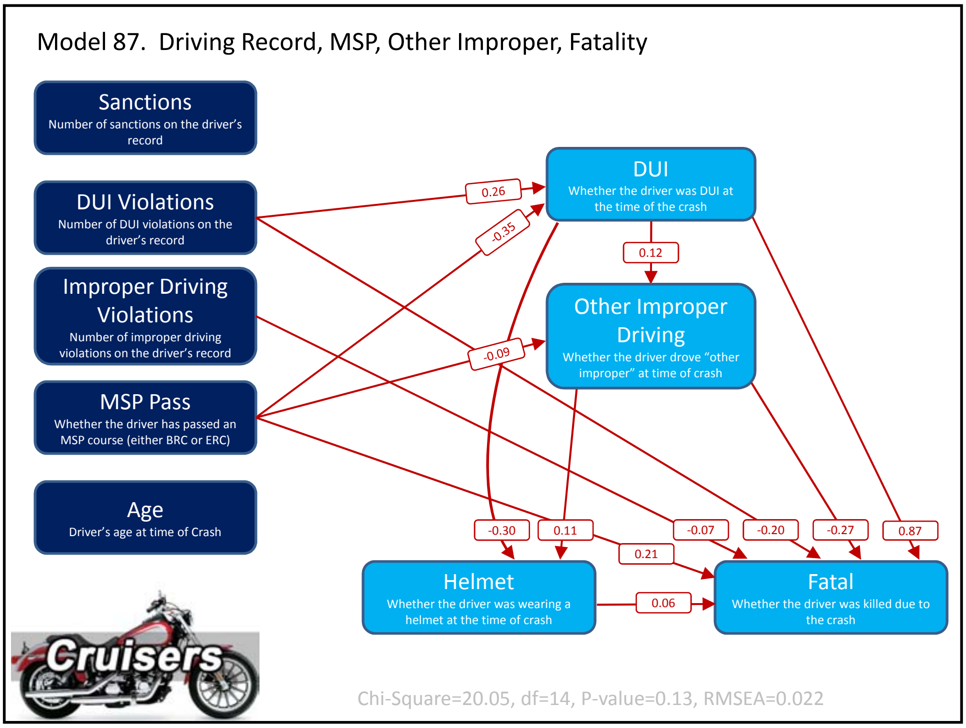
Chi-Square=48.53, df=21, P-value=0.00, RMSEA=0.039

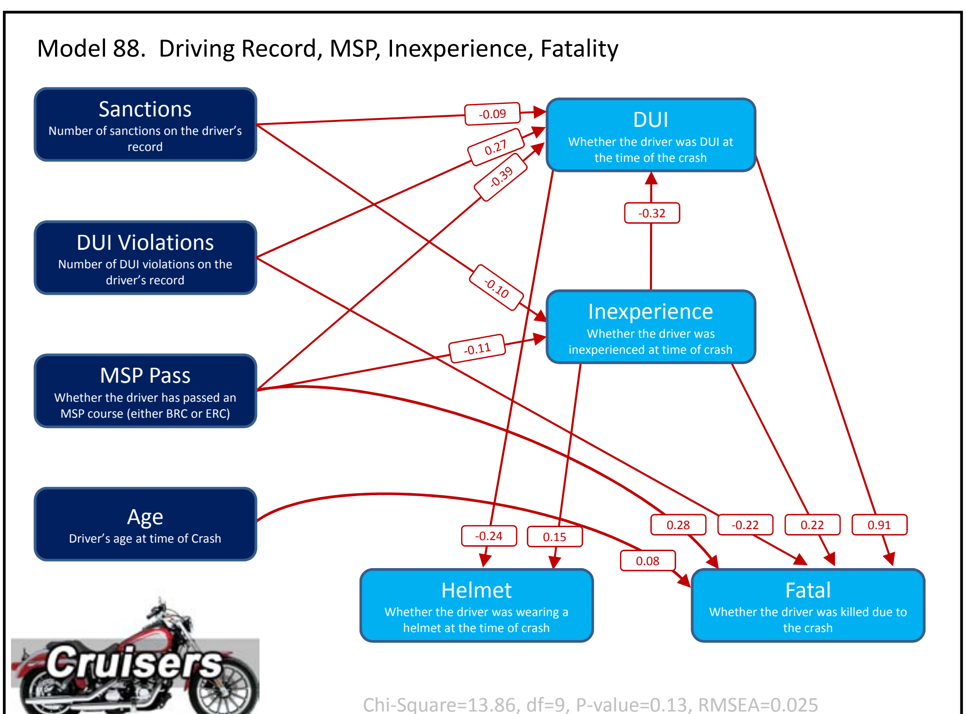

Model 83. Driving Record, MSP, Driver Actions, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.26
-0.35
0.10
0.11
-0.29
-0.10
0.43
Cruisers
Chi-Square=28.41, df=19, P-value=0.08, RMSEA=0.024


Model 84. Driving Record, MSP, Driver Actions, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Improper Driving
Whether the driver drove improperly at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.26
-0.35
0.10
0.11
-0.29
-0.22
-0.09
0.84
0.23
0.06
Cruisers
Chi-Square=28.70, df=16, P-value=0.03, RMSEA=0.030

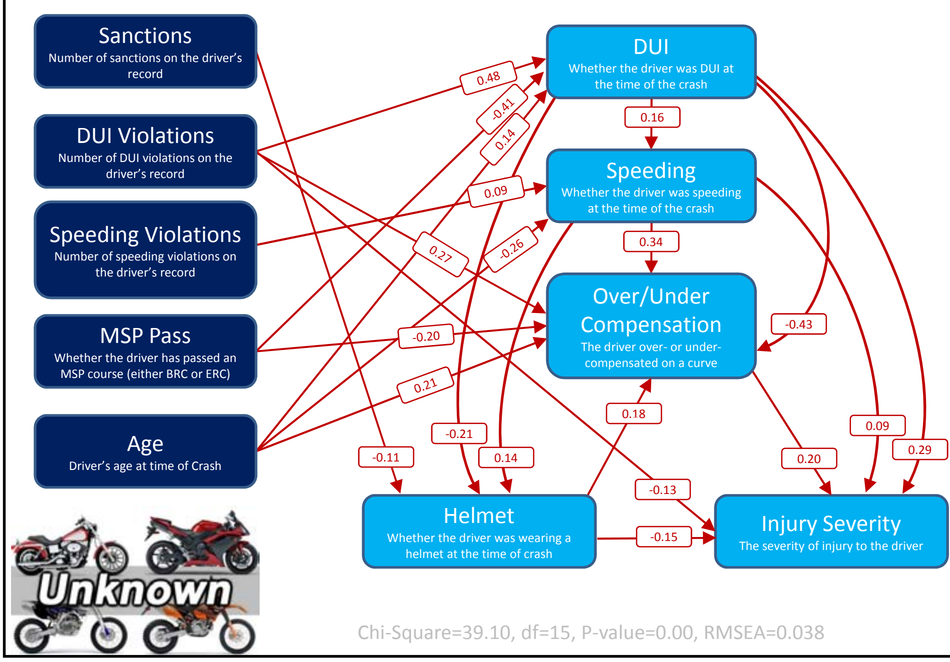

Model 85. Driving Record, MSP, Inexperience, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
-0.09
0.27
-0.39
-0.32
-0.10
-0.10
-0.07
-0.24
0.15
0.09
-0.10
0.17
0.51
Cruisers
Chi-Square=13.83, df=9, P-value=0.13, RMSEA=0.025


Model 86. Driving Record, MSP, Other Improper, Severity
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Other Improper Driving
Whether the driver drove "other improper" at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Injury Severity
The severity of injury to the driver
0.26
-0.35
0.12
-0.09
-0.30
0.11
-0.10
0.43
Cruisers
Chi-Square=19.99, df=18, P-value=0.33, RMSEA=0.011

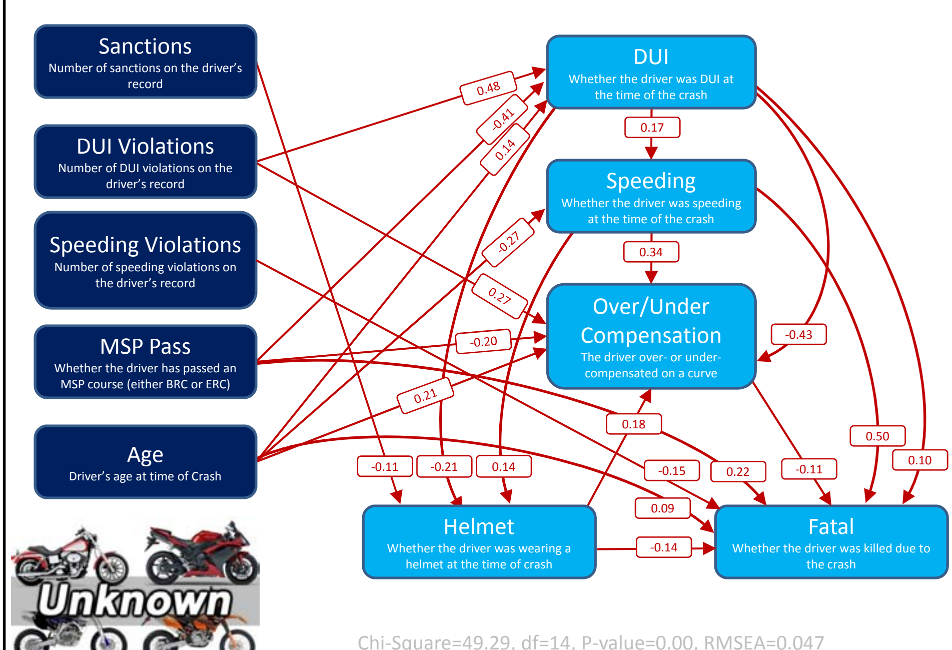

Model 87. Driving Record, MSP, Other Improper, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
Improper Driving Violations
Number of improper driving violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Other Improper Driving
Whether the driver drove "other improper" at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
0.26
-0.35
0.12
-0.09
-0.30
0.11
0.21
-0.07
-0.20
-0.27
0.87
0.06
Cruisers
Chi-Square=20.05, df=14, P-value=0.13, RMSEA=0.022


Model 88. Driving Record, MSP, Inexperience, Fatality
Sanctions
Number of sanctions on the driver's record
DUI Violations
Number of DUI violations on the driver's record
MSP Pass
Whether the driver has passed an MSP course (either BRC or ERC)
Age
Driver's age at time of Crash
DUI
Whether the driver was DUI at the time of the crash
Inexperience
Whether the driver was inexperienced at time of crash
Helmet
Whether the driver was wearing a helmet at the time of crash
Fatal
Whether the driver was killed due to the crash
-0.09
0.27
-0.39
-0.32
-0.10
-0.11
-0.24
0.15
0.08
0.28
-0.22
0.22
0.91
Cruisers
Chi-Square=13.86, df=9, P-value=0.13, RMSEA=0.025

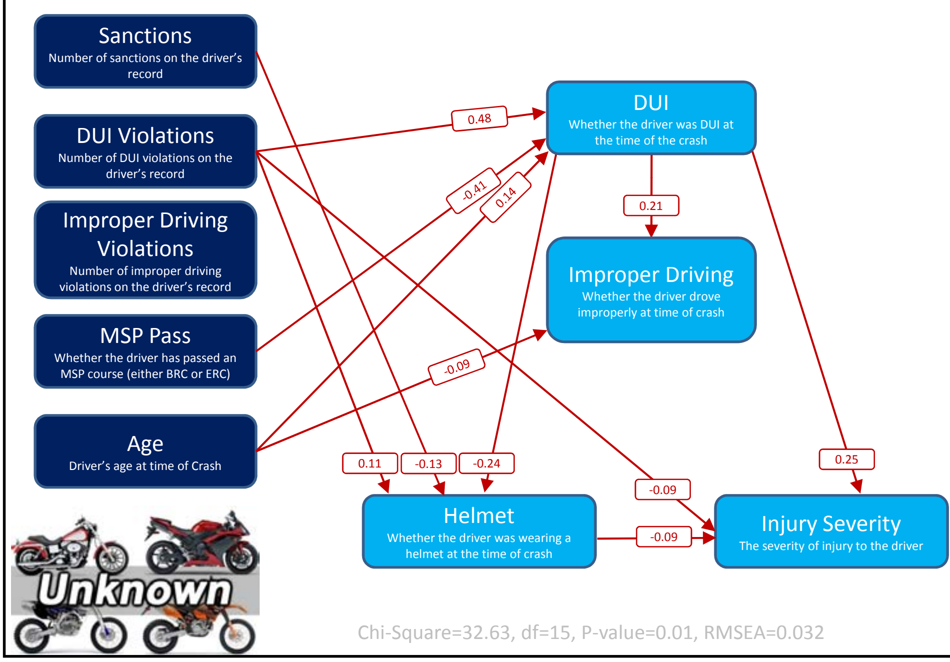
Model 89. Driving Record, MSP, Driver Actions, Severity



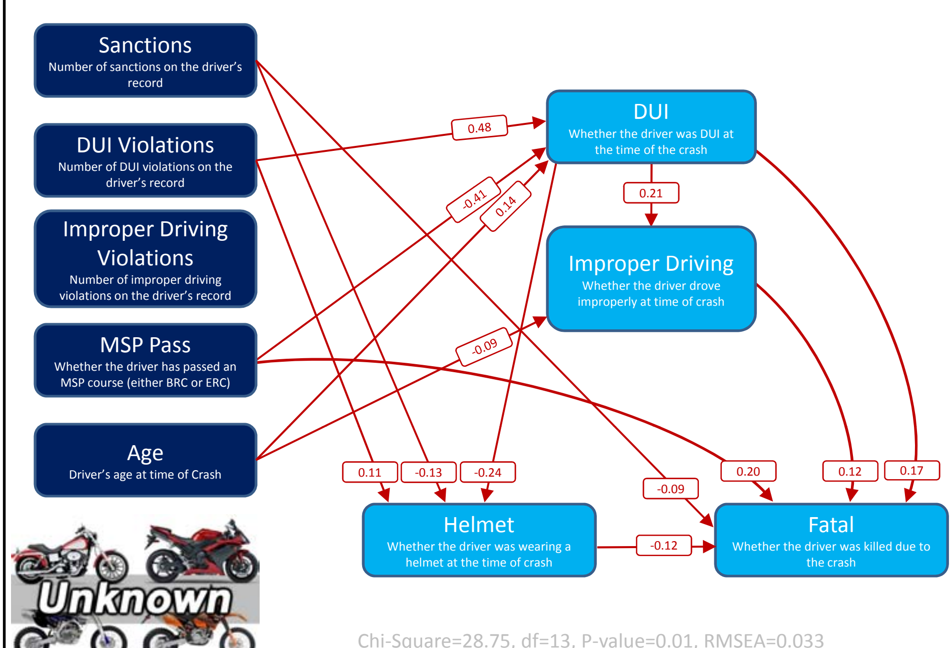
Model 90. Driving Record, MSP, Driver Actions, Fatality



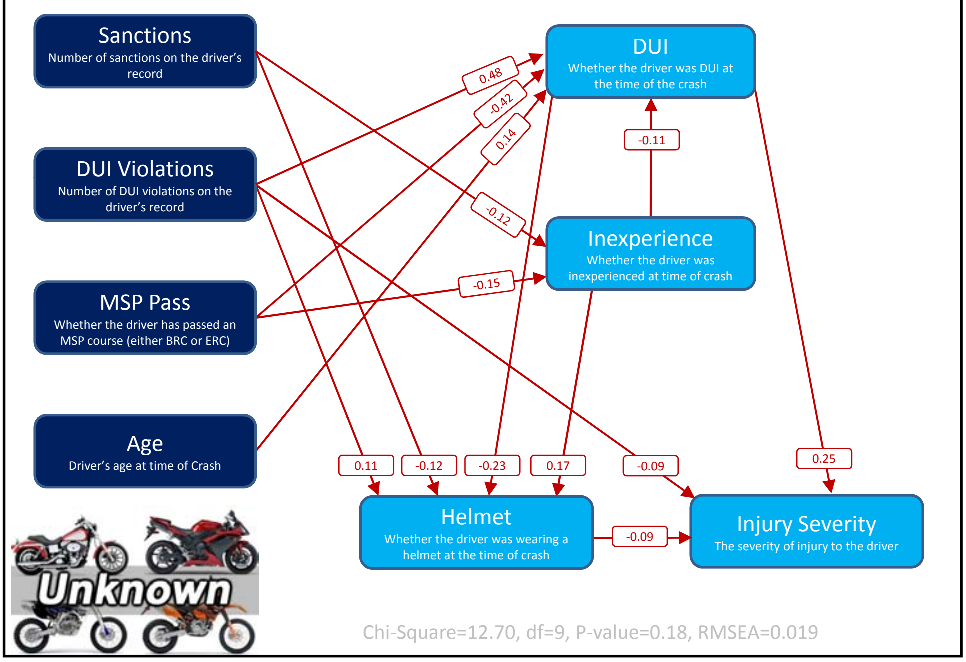
Model 91. Driving Record, MSP, Driver Actions, Severity



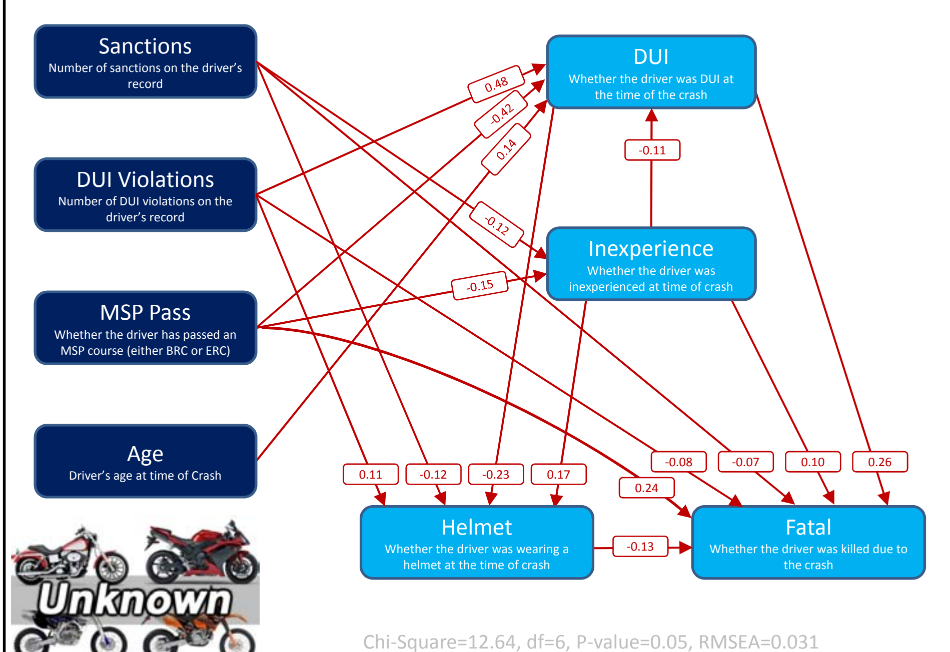
Model 92. Driving Record, MSP, Driver Actions, Fatality



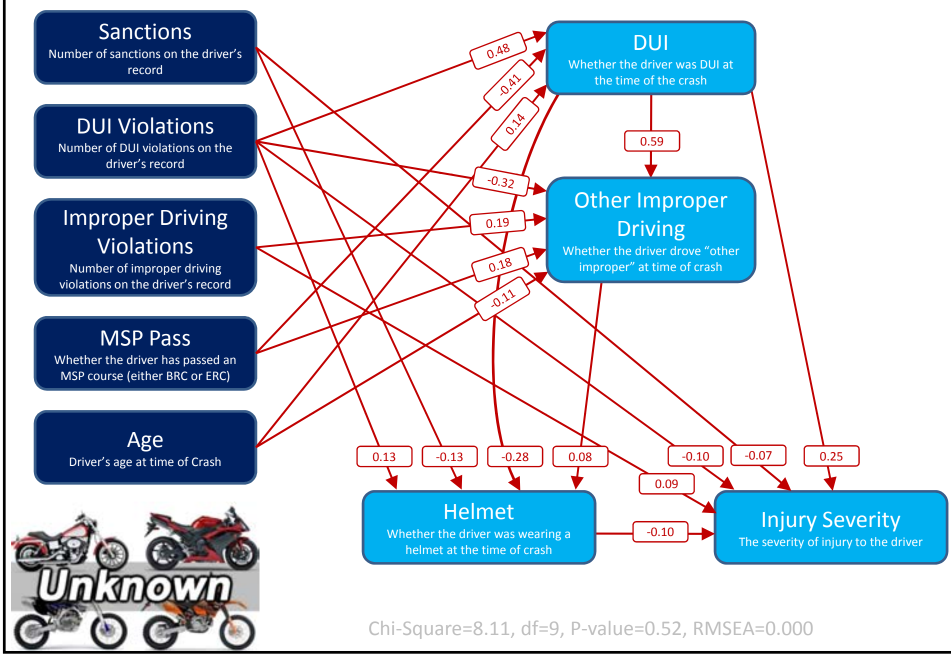
Model 93. Driving Record, MSP, Inexperience, Severity



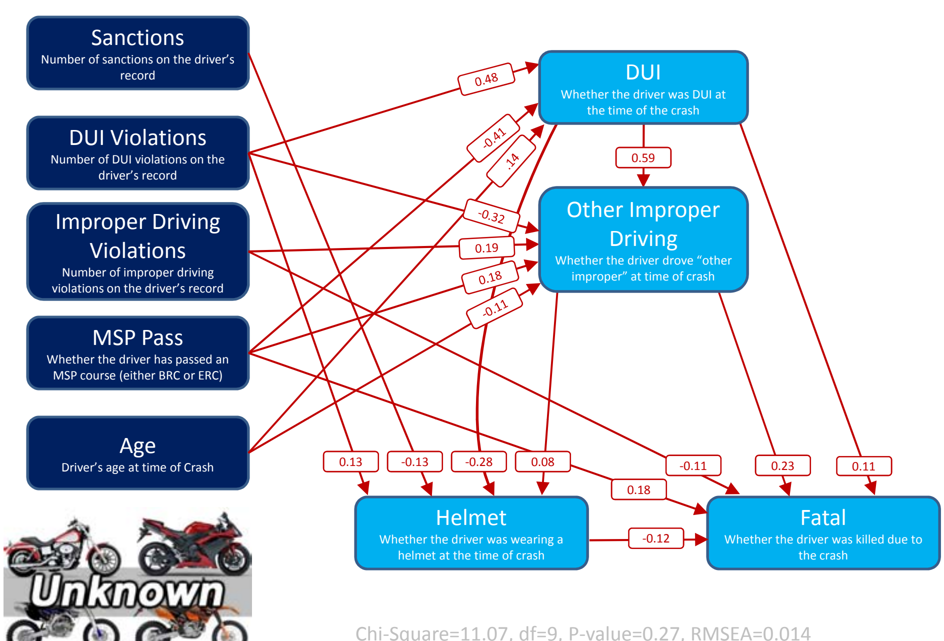
Model 94. Driving Record, MSP, Inexperience, Fatality



Model 95. Driving Record, MSP, Other Improper, Severity



Model 96. Driving Record, MSP, Other Improper, Fatality



Appendix H:
Strategies & Techniques to Improve Motorcycle Safety

Rider Education & Training

Rider Education & Training	Use	Impact	Resources Required	Time to Implement
Marketing for MSP courses				
1. Publicize MSP courses and benefits (1)	High	Med	Low	Short
MSP Course Offerings				
2. Expand MSP capacity – more courses and locations (2)	Med	Med	High	Long
3. Offer wider range of MSP courses for experienced riders (8,9)	Med	Med	Med	Med
BRC & ERC Course Content				
4. Expand material on DUI, speeding, and conspicuity (3,4,5,6)	High	High	Med	Med
Student Self-Assessment Tools				
5. Develop self-assessment of crash risk tool based on age, gender, past record of DUI, etc. (use in BRC, ERC, make available on MSP website) (7)	High	High	Med	Med
Driving Violation Sanctions				
6. Require unlicensed motorcycle driver with driving violation to pass an MSP course or incur 30-day suspension (10)	Low	High	High	Long
7. Publicize the consequences of driving a motorcycle without a license or permit (11)	Med	Med	Low	Short

Market Segment Outreach

Target Audience	Messages	General Media—Print, Radio, TV	Motorcycle Dealers	Motorcycle Clubs	National Orgs (AMA, ABATE, etc)	Rallies & Events	PennDOT (including website)	Medical Personnel	Peers who have crashed	Peers & Spouses	Virtual & Online Options
7. General audience, aspiring motorcycle drivers (12)	Benefits of license & training: Avoid points/sanctions, safer driver, courses are free, knowledge and skills	✓	✓	✓	✓		✓				✓
8. Cruiser drivers (esp. males over age 35) (16) Total: 12,054 Fatal: 604 / 5.0%	DUI kills, speed kills, DUI+speeding especially deadly. Prior DUI at particular risk: don't drink and ride, don't ride with others who do, slow down, always wear helmet, wear proper gear, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓		✓	✓
9. Motorcycle drivers who are unlikely to take an MSP course, segmented according to age (<30, >=30) (14) Total: 10,410 Fatal: 489 / 4.7%	Courses are free, knowledge and skills make safer riders, help break/avoid bad habits, recognize hazards, meet other drivers. Self-assessment tool for crash risk.	✓	✓	✓			✓	✓			✓
10. Drivers with prior speeding violations (esp. younger male sport bike drivers) (19) Total: 10,585 Fatal: 489 / 4.6%	DUI is bad, speed kills. Prior speeding at particular risk: don't drink and ride, don't ride with others who do, slow down, wear proper gear & helmet, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓	✓		✓
11. Sport bike drivers (esp. young male drivers) (15) Total: 4,654 Fatal: 289 / 6.2%	DUI is bad but speed kills; slow down, always wear helmet, wear proper gear, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓		✓	✓	✓	✓		✓

Market Segment Outreach (continued)

Target Audience	Messages	General Media—Print, Radio, TV	Motorcycle Dealers	Motorcycle Clubs	National Orgs (AMA, ABATE, etc)	Rallies & Events	PennDOT (including website)	Medical Personnel	Peers who have crashed	Peers & Spouses	Virtual & Online Options
12. Novice drivers (esp. cruiser drivers over age 30) (17) Total: 7,597 Fatal: 324 / 4.3%	Get training before riding, ride a suitable bike (size, power), don't ride beyond your abilities. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓		✓	✓
13. Drivers with multiple violations and sanctions (anyone who fits this profile) (20) Total: 6,099 Fatal: 305 / 5.0%	DUI kills, speed kills, DUI encourages speeding, DUI+speeding especially deadly. Prior DUI or speeding at particular risk; don't drink and ride, don't ride with others who do, slow down, wear proper gear & helmet, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓		✓	✓
14. Motorcycle drivers without a class M license or permit (esp. young male drivers) (13) Total: 2,675 Fatal: 227 / 8.5%	Benefits of license & training: Avoid points/sanctions, safer driver, courses are free, knowledge and skills	✓	✓	✓	✓		✓				✓
15. Drivers with prior DUIs (esp. male cruiser drivers) (18) Total: 3,219 Fatal: 160 / 5.0%	DUI kills, speed kills, DUI encourages speeding, DUI+speeding especially deadly. Prior DUI or speeding at particular risk: don't drink and ride, don't ride with others who do, slow down, wear proper gear & helmet, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓		✓	✓

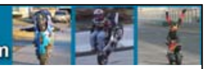
Motorcycle Safety Program Administration	Use	Impact	Resources Required	Time to Implement
Speakers Bureau				
16. Establish speakers bureau of motorcycle safety experts available to community groups (21)	Med	Med	Low	Short
17. Create PowerPoint for speakers, with tips for motorists sharing road with motorcycles (21)	Med	Med	Low	Short
Motorcycle Data Enhancements				
18. Expand PennDOT capabilities – record type of vehicle for each driving violation so motorcycle drivers are easily identified on PennDOT driving/violation records. (22)	High	High	High	Med
19. Use motorcycle type to identify typical rider characteristics and violation patterns, and to tailor educational and sanctioning practices. (22)	High	High	High	Long
20. Continue to measure annual motorcycle miles driven using roadway measuring devices (23)			High	Med
21. Continue to require drivers who renew motorcycle registrations to report annual miles driven (23)			High	Long
22. Use annual motorcycle miles driven to measure trends in crashes and fatalities and to track safety improvements (23)				
23. Relate the results of safety analyses to market segments to determine effectiveness of safety improvements by segment. (23)	High	High	High	Long

Licensing & Enforcement

	Use	Impact	Resources Required	Time to Implement
Better Enforcement of Existing Laws				
24. Encourage police to issue citations for all violations including improper license, not just violation for which driver was stopped. (24)	High	High	Low	Short
25. At checkpoints (seatbelt, Smooth Operator, etc.), provide information brochures to improperly licensed motorcycle drivers and issue citation at police officer's discretion (25)	Low	Med	Low	Short
26. Provide up-to-date information to judges about the findings of this study concerning DUI and speeding on a motorcycle and options for training. (24)	Low	Med	Low	Short
Motorcycle Hearing				
27. Screen for motorcycle drivers at hearings, provide information brochures and consider suspensions for any driver with DUI, speeding, or reckless driving violation while driving a motorcycle. (26)	Med	High	Low	Med
28. Make available motorcycle information from driver's record to hearing examiners for counseling on safe driving (26)	High	High	High	High
29. Provide improperly licensed motorcycle driver at hearing with two options, pass the MSP course and receive class M license or a 60-day suspension of currently held license (26)	Med	High	High	High

Appendix I:
Oral Presentation Annotated PowerPoint Slides

Evaluation of PA's Motorcycle Safety Program



Final Report Presentation

Vance & Renz, LLC

Robert J .Vance

Michael S. Renz

Andrew Hoskins

Hiller Consulting Group, LLC

Nathan J. Hiller

Pennoni Associates, Inc.

Mark Hood

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Barbara T. Harder

pennsylvania

DEPARTMENT OF TRANSPORTATION

Under contract to the Pennsylvania Department of Transportation, Bureau of Driver Licensing. Technical Advisor: Scott Shenk, Manager, Driver Safety Division. Presented at the Riverfront Office Center on March 24, 2009.

Objectives

- To characterize the sample of motorcycle riders, particularly those who crashed
- To evaluate factors implicated in motorcycle crashes, and whether training is effective in preventing crashes or mitigating crash outcomes
- To provide evidence-based strategies and techniques to improve the MSP and other motorcycle safety policies and practices

2

This presentation provides an overview of the major activities, findings, and conclusions of the project. The Final Report contains much greater detail.

Although the records analyzed did not provide strong empirical evidence for the effectiveness of the MSP training, the study provided a great deal of information about factors that are implicated in motorcycle crashes. Based on quantitative analyses and qualitative observations of MSP training, we conclude that the MSP is an important tool to address factors implicated in crashes, and thereby contribute to motorcycle safety.

Presentation Outline

Research Methodology

Rider Profiles

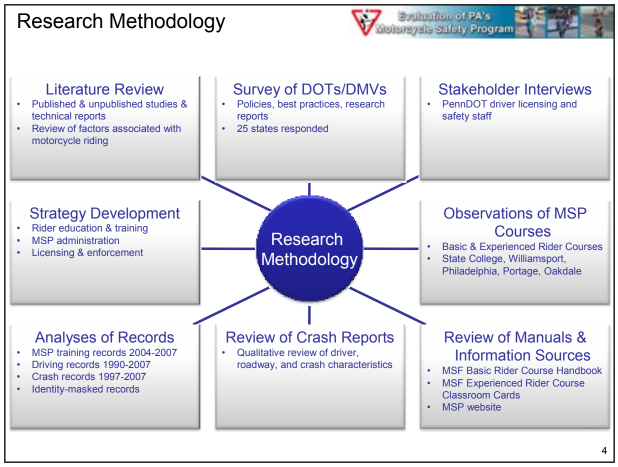
- Defining the rider population(s)
- Demographics, driving records, driver choices & actions, and crash outcomes

Motorcycle Crashes

- Modeling crash factors
- Crash factors: proportions and odds
- MSP training effectiveness

Strategy Development

- Rider Education and Training
- MSP Administration
- Licensing and Enforcement



Literature Review: 350 published and unpublished studies and reports summarized and cited

States that responded to survey: AZ, CA, CO, FL, IA, KY, ME, MS, MT, ND, NE, NJ, NM, NV, NY, OH, OK, OR, RI, SC, UT, VA, VT, WI, WV

PennDOT stakeholders interviewed: Janet Dolan, Scott Shenk, Chris Miller

Observations of MSP courses: see slide 5

Manuals and other information sources

A sample of 60 crash reports were reviewed.

Driver Records: see slide 6 for more information.

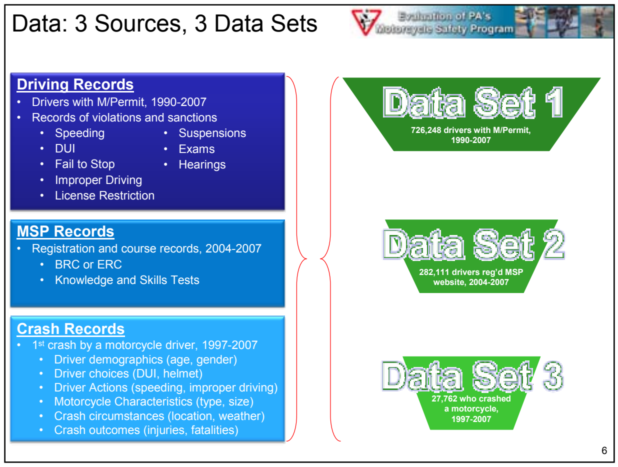
Strategy Development: See slides 26-31.

Skills Emphasized in BRC and ERC Classes

Evaluation of PA's Motorcycle Safety Program

1. Basic motorcycle features
2. Control at low speed
3. Gearing
4. Maneuverability
5. Stopping quickly
6. Control in limited space areas
7. Negotiating a curve
8. Cornering judgment and technique
9. Cornering ‘finesse’ – long curves
10. Stopping quickly on a curve
11. Hazard avoidance
12. Compound curves – different radii

Researchers attended Basic Rider Courses (BRC) and Experienced Rider Courses (ERC), in several locations, as observers. At one BRC, a researcher participated in the class as a student. These observations provided us with first-hand experience of instructional methods, course content, and student reactions to these courses, as well as variability in training practices across locations.



A series of analyses of driver records were performed. Each analysis addressed a specific research question and posed its own data requirements. This slide summarizes the data sets that were created. Because of the complexities of the various data sources, it was necessary to create three data sets rather than one, and to perform analyses in series.

Processing of driver, crash, and MSP records to create data files suitable for analyses proved to be a difficult and time-consuming task due to the complexities inherent in the source data systems.

The complexities of this very large database mean that: (1) it can be “cut” many ways to answer specific research questions; (2) most research questions are deceptively simple; (3) we analyzed a number of related questions to determine whether they pointed to a consistent set of answers – they did. Preliminary analyses revealed several important breakdowns of crash records (Data Set 3). These included single vs. multiple vehicle crashes, fatal vs. non-fatal crashes for the motorcycle driver, and breakdowns according to type of motorcycle, especially sport bikes and cruisers. Motorcycle type was coded by the researchers based on characteristics such as vehicle make, engine size, and year of manufacture.

Because of the fact that records are not kept concerning annual miles driven by individual motorcycle drivers or by annual miles driven by motorcycles on Pennsylvania roads, we do not know who is driving a motorcycle in any given year or how many miles a motorcycle is driven. We therefore do not know exposure – exposure refers to the fact that a driver who drives more miles in a given year is more likely to crash, other things being equal, than a driver who drives few or no miles in that year. For these reasons, most of our conclusions are based on analyses of Data Set 3, the crash data set, because that is the only data set where we know for sure that drivers were driving a motorcycle. Data Sets 1 and 2 included drivers with MBAC (Data Set 1) or who registered with the MSP website (Data Set 2), and these inclusion criteria reflect our assumption that these individuals may have been driving a motorcycle. But we don’t know for sure that they did, or how much if any exposure they had to crashing on a motorcycle. Most of the slides that follow (9-31) are based on Data Set 3.

Evaluation of PA's Motorcycle Safety Program

Are crashes related to driving records and/or MSP participation?

Findings of Data Set 1: Drivers with M/Permit, Odds of Crashing a Motorcycle

Driver Attribute	Odds of Crashing
Gender	Males :: Females 4 :: 1
MSP Website Registration	Registered :: Not Registered 2 :: 1
Driving Violations on Record	Has Violation(s) :: No Violations 1.5 :: 1
Sanctions on Record	Has Sanction(s) :: No Sanctions 2 :: 1
Pass MSP Course	Never Passed :: Passed 1.25 :: 1

Interpreting odds: for example, Males :: Females = 4 :: 1 means that males are 4 times more likely to crash than females.

This was the broadest data set, including everyone with an MBAC (M License or Permit) from 1990-2007. The results are not strong or very informative. They show that crashers during the 1997-2007 period were predominantly male, had records of driving violations and sanctions, and were also more likely to have registered with the MSP website. Crashers were more likely to have never passed an MSP course.

These findings highlight a shortcoming of the data: there is no measure of miles driven by motorcycle drivers, either individually or across the state. So, the finding that crashers were more likely to register with the MSP website than non-crashers probably indicates who was actually driving a motorcycle – those who drove were more likely to register. We only actually know that some drove a motorcycle if they crashed it. Most drivers with an M License or Permit did not crash during the observation period, and many who crashed did not have an M License or Permit.

Evaluation of PA's Motorcycle Safety Program

Among MSP website registrants, were drivers who passed 1 or more courses less likely to crash?

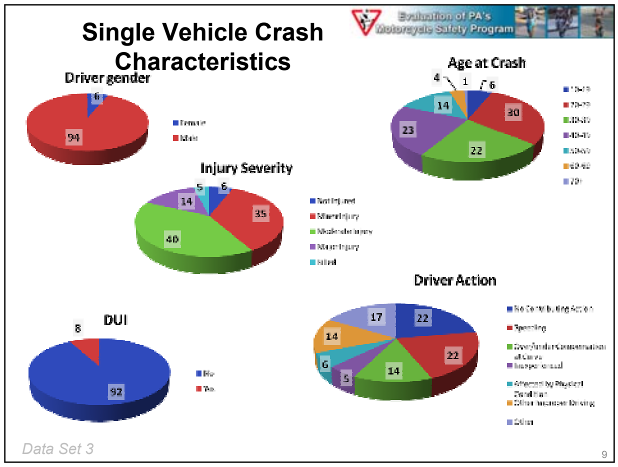
Findings of Data Set 2: MSP website registrants with initial M/Permit after April 1, 2004, Odds of Crashing a Motorcycle

MSP Activity	Odds of Crashing
Pass MSP Course	Passed :: Never Passed 1.25 :: 1
ERC Registration	Registered :: Not Registered 1.75 :: 1
Skills Test Score	High Score :: Low Score 1.5 :: 1
Knowledge Test Score	Low Score :: High Score 1.25 :: 1

8

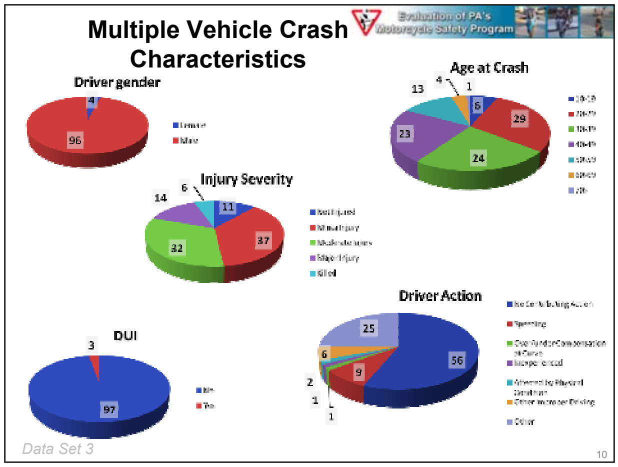
Interpreting odds: for example, Passed :: Never Passed = 1.25 :: 1 means that those who passed an MSP course are slightly more likely to crash than those who did not take or did not pass an MSP course.

These analyses focused on the question of whether crashes were related to MSP activity, specifically focusing on drivers who were likely to have begun driving after the start of the period of MSP records provided for analysis (i.e., April 1, 2004). There were few significant findings. Those who passed an MSP course, or registered for ERC, or obtained a high skills test score, were slightly more likely to crash. As noted with respect to slide 7, this probably indicates who was actually driving a motorcycle, rather than the effectiveness of training.

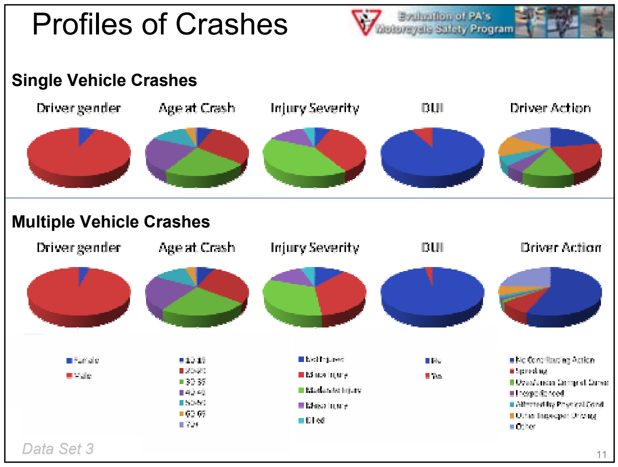


This is the first slide to summarize findings of Data Set 3, including all first crashes by motorcycle drivers with a PA license during 1997-2007.

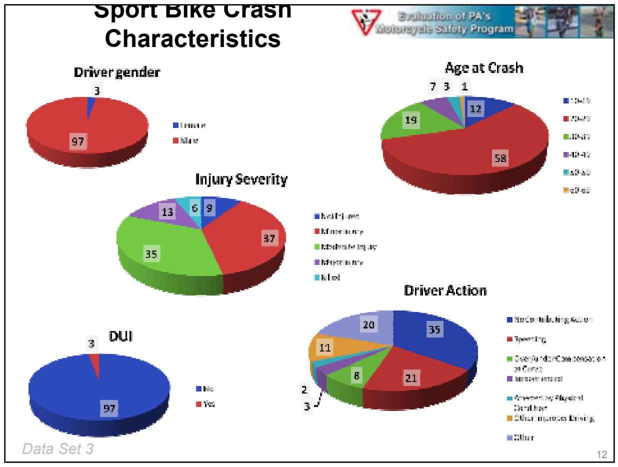
Of 27,762 crashes, 13,025 or 47% were single vehicle crashes.



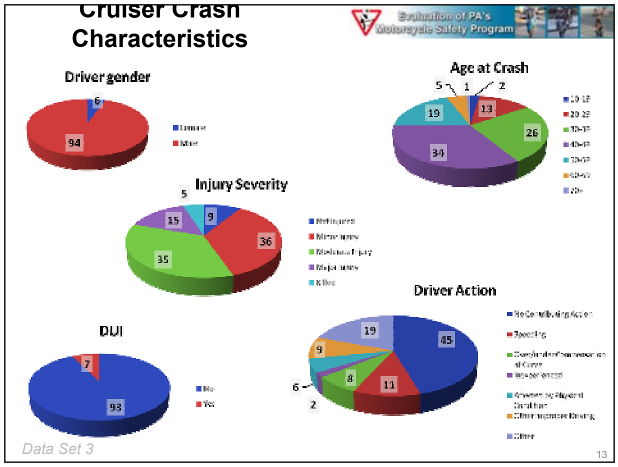
Of 27,762 crashes, 14,737 or 53% were multiple vehicle crashes.



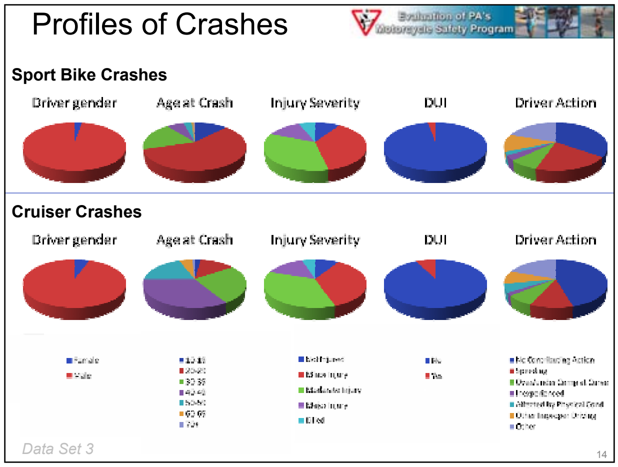
This slide shows how single and multiple vehicle crashes differ, especially on contributing driver actions.



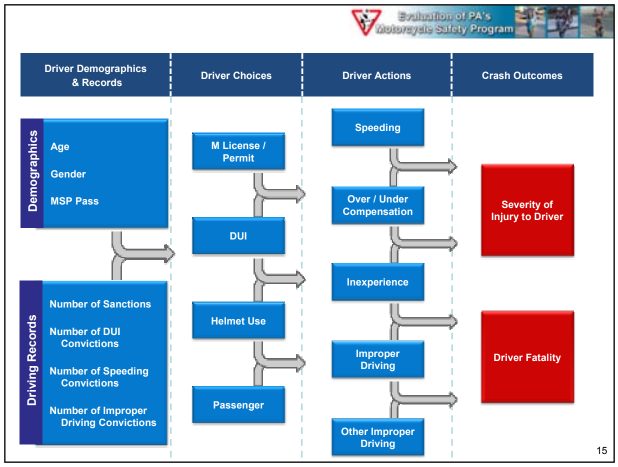
Motorcycle type was coded by the researchers based on characteristics such as vehicle make, engine size, and year of manufacture. Of 27,762 crashes, 5,129 or 18.5% were sport bike crashes. Most (70%) sport bike crashers were under age 30.



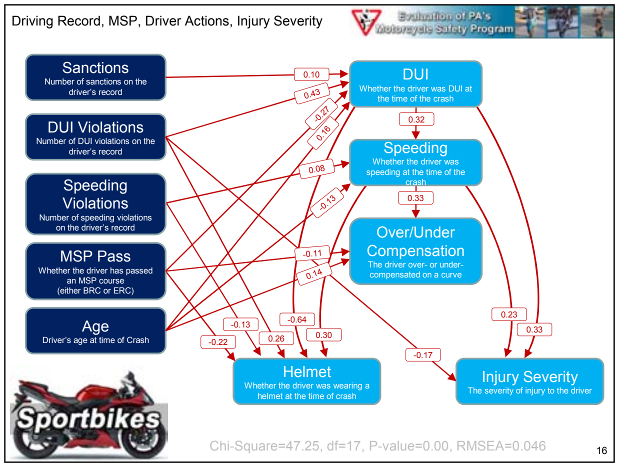
Motorcycle type was coded by the researchers based on characteristics such as vehicle make, engine size, and year of manufacture. Of 27,762 crashes, 13,216 or 47.6% were cruiser crashes. Most (79%) cruiser crashers were between the ages of 30 and 59.



This slide shows how sport bike and cruiser crashes differ, especially on driver age, DUI, and contributing driver actions.

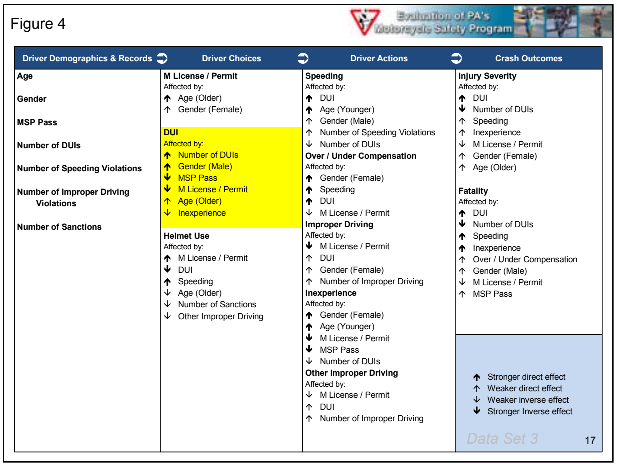


Considering crash characteristics one at a time is informative, but simple descriptive statistics do not reveal relationships among variables. This figure lays out the variables studied in path analyses, and the conceptual relationships among them. Preliminary analyses led us to chose these as the factors to include in the models.



This figure illustrates a typical path diagram. It is animated to give an idea of how the model is built and what it shows – i.e., which variables are related, which are not, and what "causes" what. Model fit statistics are shown at the bottom – these are used to evaluate whether the model is a plausible explanation of the observed data. All models reported achieved very good statistical fit.

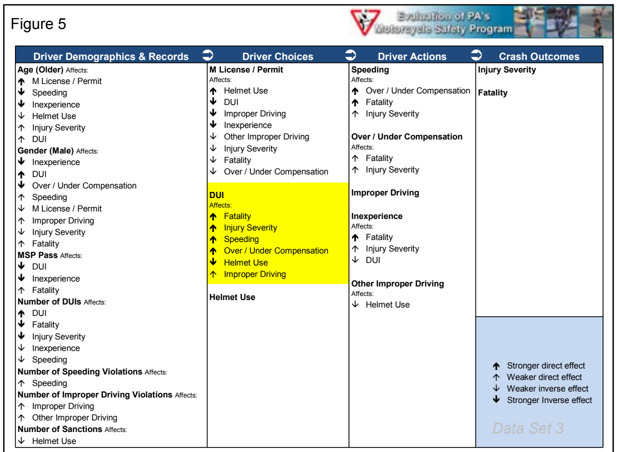
The path coefficients shown are standardized, which means they are directly comparable – path coefficients that are approximately equal in value indicate effects of approximately equal magnitude, and path coefficients that differ in magnitude in absolute terms reflect effects that differ proportionally in effect sizes. This is important is interpreting findings. The Final Report describes 96 path models in all. This large number of models was necessary due to requirements imposed by data sources and characteristics of variables. See Final Report for more information.



A total of 96 path models were tested. This large number of models was required by the characteristics and complexities of the data sources. This figure provides a high level summary of what was found in testing these models. As with the conceptual model of slide 15, factors are organized by driver demographics and driving record variables, driver choices, driver actions, and crash outcomes. This figure shows which factors are affected by which other factors, plus the direction and strength of relationships. For example, older drivers are substantially more likely to have an M-License/Permit than younger drivers, and female drivers are somewhat more likely to have an M-License/Permit than male drivers.

The factors in the left column, driver demographics and driver records, are called "exogenous," meaning that their causes are beyond the scope of the model. Therefore, no factors are listed as affecting them. The factors in the remaining three columns are called "endogenous," meaning that at least some of their causes are included in the model.

Figure 5



A total of 96 path models were tested. This large number of models was required by the characteristics and complexities of the data sources. This figure provides a high level summary of what was found in testing these models. It is complementary to slide 17. As with the conceptual model of slide 15, factors are organized by driver demographics and driving record variables, driver choices, driver actions, and crash outcomes. This figure shows which factors affected which other factors, plus the direction and strength of relationships. For example, older drivers are substantially more likely to have an M-License/Permit, and substantially less likely to speed, than younger drivers.

Table 25. Contributing Factors to Fatal and Non-Fatal Crashes by Major Crash Categories, 1997-2007

	Crashes		DUI at time of Crash		Speeding at time of Crash		M / Permit Ever	
Fatal Crashes	Number	Percent of Total	Number	Percent of Fatal	Number	Percent of Fatal	Number	Percent of Fatal
All Crashes	1,263	5%	405	32%	536	42%	1,036	82%
Single Vehicle	536	5%	235	44%	284	53%	444	83%
Multiple Vehicle	727	5%	170	23%	252	35%	592	81%
Sport Bike	289	6%	49	17%	168	58%	226	78%
Cruiser	604	5%	267	44%	203	34%	540	89%
Unknown Bike Type	335	4%	74	22%	159	47%	253	76%
Non-Fatal Crashes	Number	Percent of Total	Number	Percent of Non-Fatal	Number	Percent of Non-Fatal	Number	Percent of Non-Fatal
All Crashes	23,848	95%	980	4%	4,290	18%	21,400	90%
Single Vehicle	11,342	95%	760	7%	3,003	26%	10,123	89%
Multiple Vehicle	12,506	95%	220	2%	1,287	10%	11,277	90%
Sport Bike	4,365	94%	88	2%	1,053	24%	3,870	89%
Cruiser	11,450	95%	650	6%	1,641	14%	10,806	94%
Unknown Bike Type	7,263	96%	219	3%	1,492	21%	6,164	85%

Data Set 3

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Note. Total Number of Crashes: All - 25,111; Single Vehicle - 11,878; Multiple Vehicle - 13,233; Sport Bike - 4,654; Cruiser - 12,054;

Unknown Bike Type - 7,598. Percent of Total = Number of Crashes / Total Number of Crashes (e.g. 1,263 / 25,111 = 5%) .

Percent of Fatal/Non-Fatal = Number of DUI or Speeding or MBAC / Number of Crashes (e.g. 405 / 1,263 = 32%).

Percentages relative to totals are shown in column 3 (total crashes by category are given in the table note). Thus, reading down column 2, fatal crashes range from 4% to 6% of crashes across categories, and, conversely, non-fatal crashes range from 94% to 96%.

Column 4 of Table 25 reports the numbers of drivers in fatal and non-fatal crashes who were DUI at the time of the crash, and column 5 shows the associated percentages, calculated as the number DUI divided by the number of crashes shown in the same row. Thus, of 1,263 fatal crashes (shown in the first row of data), 405 of these drivers were DUI at the time of the crash, or 32%. This compares to only 4% of drivers involved in all non-fatal crashes who were DUI. Although the number of DUI drivers involved in all non-fatal crashes (980) is more than twice as large as the number of DUI drivers in all fatal crashes (405), the percent of DUI drivers in non-fatal crashes is much lower than the percent of DUI drivers in fatal crashes because of the much larger number of non-fatal (23,848) vs. fatal (1,263) crashes. This dramatic difference in the proportions of drivers who were DUI in fatal vs. non-fatal crashes (32% vs. 4%) explains why the Series 1 and 2 Models showed such large effects of DUI on crash outcomes.

Column 5 of Table 25 also reveals that the proportions of DUI drivers in fatal crashes varied considerably across crash categories. Drivers in single vehicle fatal crashes were almost twice as likely to be DUI as drivers in multiple vehicle fatal crashes (44% vs. 23%). Drivers in fatal cruiser crashes were twice as likely to be DUI as drivers in unknown bike type fatal crashes (44% vs. 22%), and more than twice as likely to be DUI as sport bike drivers in fatal crashes (44% vs. 17%). Thus, DUI played an important role in fatalities for all types of motorcycle crashes, but the magnitude of influence varied considerably by crash category.

Table 27. Odds Ratios by Major Crash Categories

Evaluation of PA's Motorcycle Safety Program

	All Crashes	Sport Bike Crashes	Cruiser Crashes	Unknown Bike Type Crashes
Odds of Fatality if:				
DUI	11 :: 1	10 :: 1	13 :: 1	9 :: 1
Speeding	3 :: 1	4 :: 1	3 :: 1	3 :: 1
No Helmet	1.25 :: 1	1.25 :: 1	1.25 :: 1	1.25 :: 1
DUI & Speeding	22 :: 1	23 :: 1	23 :: 1	19 :: 1
DUI, Speeding, & No MBAC	33 :: 1	60 :: 1	29 :: 1	29 :: 1
Odds of DUI if:				
1 or More DUI Violations	8 :: 1	10 :: 1	6 :: 1	13 :: 1
Gender (Male)	4 :: 1	2 :: 1	5 :: 1	3 :: 1
Odds of Speeding if:				
DUI	3 :: 1	3 :: 1	3 :: 1	3 :: 1
2 or More Speeding Violations	1.5 :: 1	1.5 :: 1	1.5 :: 1	1.5 :: 1
Driver Age (< 30)	2 :: 1	1.5 :: 1	1.5 :: 1	2 :: 1
Odds of No Helmet if:				
DUI	2 :: 1	1.5 :: 1	1.75 :: 1	2 :: 1
No MBAC	3 :: 1	3 :: 1	1.75 :: 1	4 :: 1
Driver Age (30+)	1.25 :: 1	1.5 :: 1	1.25 :: 1	1 :: 1
Odds of No MBAC Ever if:				
Gender (Male)	1.25 :: 1	3 :: 1	1.25 :: 1	1.5 :: 1
Driver Age (Younger)	3 :: 1	1.25 :: 1	3 :: 1	2 :: 1
Odds of DUI if (post-MSP Sample):				
1 or More DUI Violations	11 :: 1	18 :: 1	5 :: 1	28 :: 1
No MSP Pass	4 :: 1	5 :: 1	5 :: 1	9 :: 1
MSP Pass & 1 or More DUI	1.25 :: 1	NS	2 :: 1	NS
No MSP Pass & 1 or More DUI	27 :: 1	38 :: 1	15 :: 1	83 :: 1

Data Set 3

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Note. Odds compare worst to best case scenarios: DUI to not DUI, speeding to not speeding, etc. Thus, the likelihood of death for a DUI driver in a crash is 11 times greater than the likelihood of death for a non-DUI driver in a crash. For combinations, the comparison is to the opposite for each variable in the combination; for example, crashes in which the driver is DUI and speeding without MBAC are compared to crashes in which the driver is not DUI, not speeding, and had MBAC. Odds shown between 1 and 2 are rounded to the nearest .25 percent; odds of 2::1 or greater are rounded to the nearest whole number. NS indicates that odds could not be calculated due to an insufficient number of “MSP Pass & 1 or More DUI” cases that were DUI at time of crash.

An odds ratio can be interpreted at the level of an individual driver. What are the odds that a DUI driver in a crash will be killed? What are the odds that a speeding driver in a crash will be killed? What are the odds that a driver in a crash who is both DUI and speeding will be killed? Table 27 displays odds that answer these and similar questions. As noted with the previous slide, considering fatalities shows the effects of contributing crash factors in the starkest terms. Table 27 also shows, however, that odds ratios can be calculated for any causal relationship in the models.

Table 28. Odds Ratios for MSP Pass Comparisons

Evaluation of PA's Motorcycle Safety Program

	All Crashes	Sport Bike Crashes	Cruiser Crashes	Unknown Bike Type Crashes
If No MSP Course Taken or Passed, Odds of:				
Driver Fatality	1.25 :: 1	2 :: 1*	1.25 :: 1	0.50 :: 1*
Speeding	1.5 :: 1*	1.25 :: 1	1.25 :: 1*	1.75 :: 1*
Over/Under Compensation at Curve	1 :: 1	1.25 :: 1	1 :: 1	1 :: 1
Improper Driving	1 :: 1	0.75 :: 1	1 :: 1	1 :: 1
Other Improper Driving	1.5 :: 1*	1.25 :: 1	1.75 :: 1*	1.5 :: 1*
Inexperience	1.5 :: 1*	2 :: 1*	1.5 :: 1*	1.5 :: 1*
DUI	4 :: 1*	5 :: 1*	5 :: 1*	9 :: 1*
Helmet Use	1 :: 1	1.25 :: 1	0.75 :: 1*	0.75 :: 1*
If MSP Course Passed, Odds of:				
Driver Fatality	0.75 :: 1	0.50 :: 1*	0.75 :: 1	2 :: 1*
Improper Driving	1 :: 1	1.25 :: 1	0.75 :: 1*	1 :: 1
Helmet Use	1 :: 1	0.75 :: 1	1.25 :: 1*	1.25 :: 1*

Data Set 3

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Note. Odds ratios are calculated on 3,579 motorcycle drivers with an initial MBAC date between April 2004 and December 2007 who crashed. Odds compare drivers who passed an MPS course to drivers who did not take or did not pass an MSP course. Thus, the likelihood of death for a driver in a crash who did not take or pass an MSP course is 1.25 times greater than the likelihood of death for a driver in a crash who passed an MSP course. Odds less than 1 (e.g., 0.50::1) indicate an inverse relationship. Odds of driver fatality were *greater* if no MSP course was taken or passed for all crashes, sport bike, and cruiser crashes, but fatality odds for unknown bike type crashes were *less* if no MPS course was taken or passed. Corresponding direct odds are shown in the second section of the table, where odds of a driver fatality for unknown bike types are 2::1 for drivers who passed an MSP course. Odds shown between 1 and 2 are rounded to the nearest .25 percent; odds of 2::1 or greater are rounded to the nearest whole number. Statistically significant odds (i.e., greater than chance odds of 1::1) are noted by *.

As shown in slides 17 and 18, Table 29 also reveals that the greatest effect of passing an MSP course is in the likelihood of a DUI-related crash – drivers who have not taken or passed an MSP course were 4 times or more likely to be DUI at crash than drivers with MSP Pass.

Summary of Major Findings

Evaluation of PA's Motorcycle Safety Program

DUI

- DUI had a greater impact on injury severity and fatalities than any other factor
- DUI drivers were more likely to speed and less likely to wear a helmet
- Odds of DUI at crash were 8 times greater for drivers with 1 or more DUI violations on record
- 50% reduction in incidence of DUI among cruiser drivers would yield a reduction of 133 fatalities over 11 years of crash records studied, or about 12 fewer deaths per year

Summary of Major Findings

Speeding

- Speeding drivers suffered more severe injuries and fatalities, especially sport bike riders
- Younger drivers were more likely to speed than older drivers
- Males were more likely to speed than females
- Odds of speeding at crash time were 3 times greater for DUI drivers, and 1.5 times greater for drivers with 1 or more speeding violations on record
- 50% reduction in incidence of speeding among all motorcycle drivers would yield a reduction of 268 fatalities over 11 years of crash records studied, or about 24 fewer deaths per year

Summary of Major Findings

M-License/Permit Ever

- Drivers with M/Permit sustained somewhat less severe injuries than drivers without M/Permit
- M/Permit drivers were more likely to wear a helmet than drivers without M/Permit
- Older drivers were more likely than younger drivers to have an M/Permit
- Females were somewhat more likely than males to have an M/Permit
- If motorcycle drivers without M/Permit were properly licensed (having demonstrated the requisite knowledge and skills), we expect that they would drive more safely with fewer crashes

Summary of Major Findings

MSP

- Drivers who passed an MSP course were *less* likely to be DUI
- DUI, speeding, and not wearing a helmet each increases the odds of a fatality in a crash; these factors in combination greatly increase the odds of fatality
- A DUI & speeding sport bike driver without a helmet was **43 times** more likely to die than a non-DUI, non-speeding helmeted sport bike driver
- A motorcycle rider can substantially reduce his or her chances of severe injury and death in a crash – DUI, speeding, helmet use, proper licensure, and training are driver choices
- MSP courses and other rider education initiatives can help riders make better riding choices

Three Primary Themes

Three primary themes underlie our suggestions for improvement strategies and techniques:

- **Subpopulations:** Pennsylvania motorcycle riders comprise several distinct subpopulations, differing on age, gender, types of motorcycles driven, and past driving records. Targeted rider education messages and media should be used.
- **Risk Profiles:** Understanding individual crash risk profiles based on age, gender, and past driving records would be beneficial to drivers, to PennDOT, and to others who promote motorcycle safety. Training motorcycle drivers should take their individual risk profiles into account, as should PennDOT's sanctions for unsafe motorcycle driving.
- **Better Data:** To effectively address subpopulations of motorcycle drivers and account for their individual risk profiles, PennDOT must have better data than available currently, particularly concerning individual driving records that pertain to motorcycle driving.

Strategies & Techniques

Rider Education & Training

	Use	Impact	Resources Required	Time to Implement
Marketing for MSP courses				
1. Publicize MSP courses and benefits	High	Med	Low	Short
MSP Course Offerings				
2. Expand MSP capacity – more courses and locations	Med	Med	High	Long
3. Offer wider range of MSP courses for experienced riders	Med	Med	Med	Med
BRC & ERC Course Content				
4. Expand material on DUI, speeding, and conspicuity	High	High	Med	Med
Student Self-Assessment Tools				
5. Develop self-assessment of crash risk tool based on age, gender, past record of DUI, etc. (use in BRC, ERC, make available on MSP website)	High	High	Med	Med
Driving Violation Sanctions				
6. Require unlicensed motorcycle driver with driving violation to pass an MSP course or incur 30-day suspension	Low	High	High	Long

High, medium, and low are used as relative terms. For Time to Implement, Short = up to 6 months, Medium = up to 1 year, Long = 1 year or longer.

Evaluation of PA's Motorcycle Safety Program

Market Segment Outreach

Target Audience	Messages	General Media—Print, Radio, TV	Motorcycle Dealers	Motorcycle Clubs	AAA & others	Rallies & Events	PennDOT (including website)	Medical Personnel	Peers who have crashed	Peers & Spouses	Virtual & Online Options
7. General audience, aspiring motorcycle drivers	Benefits of license/training. Avoid points/sanctions, safer driver, courses are free, knowledge and skills	✓	✓	✓	✓		✓				✓
8. Cruiser drivers (esp. males over age 35) Total: 12,8[illegible] Fatal: [illegible]	DUI kills, speed kills. DUI [illegible] especially deadly. Prior DUI at particular risk: don't drink and ride, don't ride with others who do, slow down, always wear helmet, wear proper gear, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓		✓	✓
9. Motorcycle drivers who are unlikely to take an MSP course, segmented according to age (<30, >=30) Total: 10,410 Fatal: [illegible]	Courses are free, knowledge and skills make safer riders, help break bad habits, recognize hazards, meet other drivers. Self-assessment tool for crash risk.	✓	✓	✓			✓	✓			✓
10. Drivers with prior speeding violations (esp. younger male sport bike drivers) Total: 10,656 Fatal: 489 / 4.5%	DUI is bad, speed kills. Prior speeding at particular risk: don't drink and ride, don't ride with others who do, slow down, wear proper gear & helmet, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓	✓		✓
11. Sport bike drivers (esp. young male drivers) Total: 4,654 Fatal: [illegible]	DUI is bad, but speed kills, slow down, always wear helmet, wear proper gear, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓		✓	✓	✓	✓		✓

Market Segment Outreach (continued)

Target Audience	Messages	General Media—Print, Radio, TV	Motorcycle Dealers	Motorcycle Clubs	AAA & others	Rallies & Events	PennDOT (including website)	Medical Personnel	Peers who have crashed	Peers & Spouses	Virtual & Online Options
12. Novice drivers (esp. cruiser drivers over age 30) Total: [illegible] Fatal: [illegible] / 4.3%	Get training before riding, ride a suitable bike (size, power), don't ride beyond your abilities. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓		✓	✓
13. Drivers with multiple violations and sanctions (anyone who fits this profile) Total: [illegible] Fatal: [illegible]	DUI kills, speed kills, DUI encourages speeding. DUI+speeding especially deadly. Prior DUI or speeding at particular risk: don't drink and ride, don't ride with others who do, slow down, wear proper gear & helmet, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓		✓	✓
14. Motorcycle drivers without a class M license or permit (esp. young male drivers) Total: [illegible] Fatal: [illegible]	Benefits of license & training. Avoid points/sanctions, safer driver, [illegible] knowledge and skills	✓	✓	✓	✓		✓				✓
15. Drivers with prior DUIs (esp. male cruiser drivers) Total: [illegible] Fatal: [illegible] / 5.3%	DUI kills, speed kills, DUI encourages speeding. DUI+speeding especially deadly. Prior DUI or speeding at particular risk: don't drink and ride, don't ride with others who do, slow down, wear proper gear & helmet, be visible to other drivers. Self-assessment tool for crash risk.		✓	✓	✓	✓	✓	✓		✓	✓

Motorcycle Safety Program Administration

	Use	Impact	Resources Required	Time to Implement
Speakers Bureau				
16. Establish speakers bureau of motorcycle safety experts available to community groups	Med	Med	Low	Short
17. Create PowerPoint for speakers, with tips for motorists sharing road with motorcycles	Med	Med	Low	Short
Motorcycle Data Enhancements				
18. Expand PennDOT capabilities – record type of vehicle for each driving violation so motorcycle drivers are easily identified on PennDOT driving/violation records.	High	High	High	Med
19. Use motorcycle type to identify typical rider characteristics and violation patterns, and to tailor educational and sanctioning practices.	High	High	High	Long
20. Measure annual motorcycle miles driven using roadway measuring devices			High	Med
21. Continue to require drivers who renew motorcycle registrations to report annual miles driven			High	Long
22. Continue to use annual motorcycle miles driven to measure trends in crashes and fatalities and to track safety improvements				
23. Relate the results of safety analyses to market segments to determine effectiveness of safety improvements by segment.	High	High	High	Long

Licensing & Enforcement

	Use	Impact	Resources Required	Time to Implement
Better Enforcement of Existing Laws				
24. Encourage police to issue citations for all violations including improper license, not just violation for which driver was stopped.	High	High	Low	Short
25. At checkpoints (seatbelt, Smooth Operator, etc.), provide information brochures to improperly licensed motorcycle drivers and issue citation at police officer's discretion	Low	Med	Low	Short
26. Provide up-to-date information to judges about the findings of this study concerning DUI and speeding and training options.	Low	Med	Low	Short
Motorcycle Hearing				
27. Screen for motorcycle drivers at hearings, provide information brochures and consider suspensions for any driver with DUI, speeding, or reckless driving violation while driving a motorcycle.	Med	High	Low	Med
28. Make available motorcycle information from driver's record to hearing examiners for counseling on safe driving	High	High	High	High
29. Provide improperly licensed motorcycle driver at hearing with two options, pass the MSP course and receive class M license or a 30-day suspension of currently held license	Med	High	High	High

MSP Contributions to PennDOT Safety Goals

- Outreach efforts for MSP
  - marketing, speakers bureau, publicize the MSP courses
- Enhance BRC/ERC course content
- Develop self-assessment tools
- Institute motorcycle hearings
- Further joint efforts with enforcement bodies
- Data enhancements
- Violations and sanction changes

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